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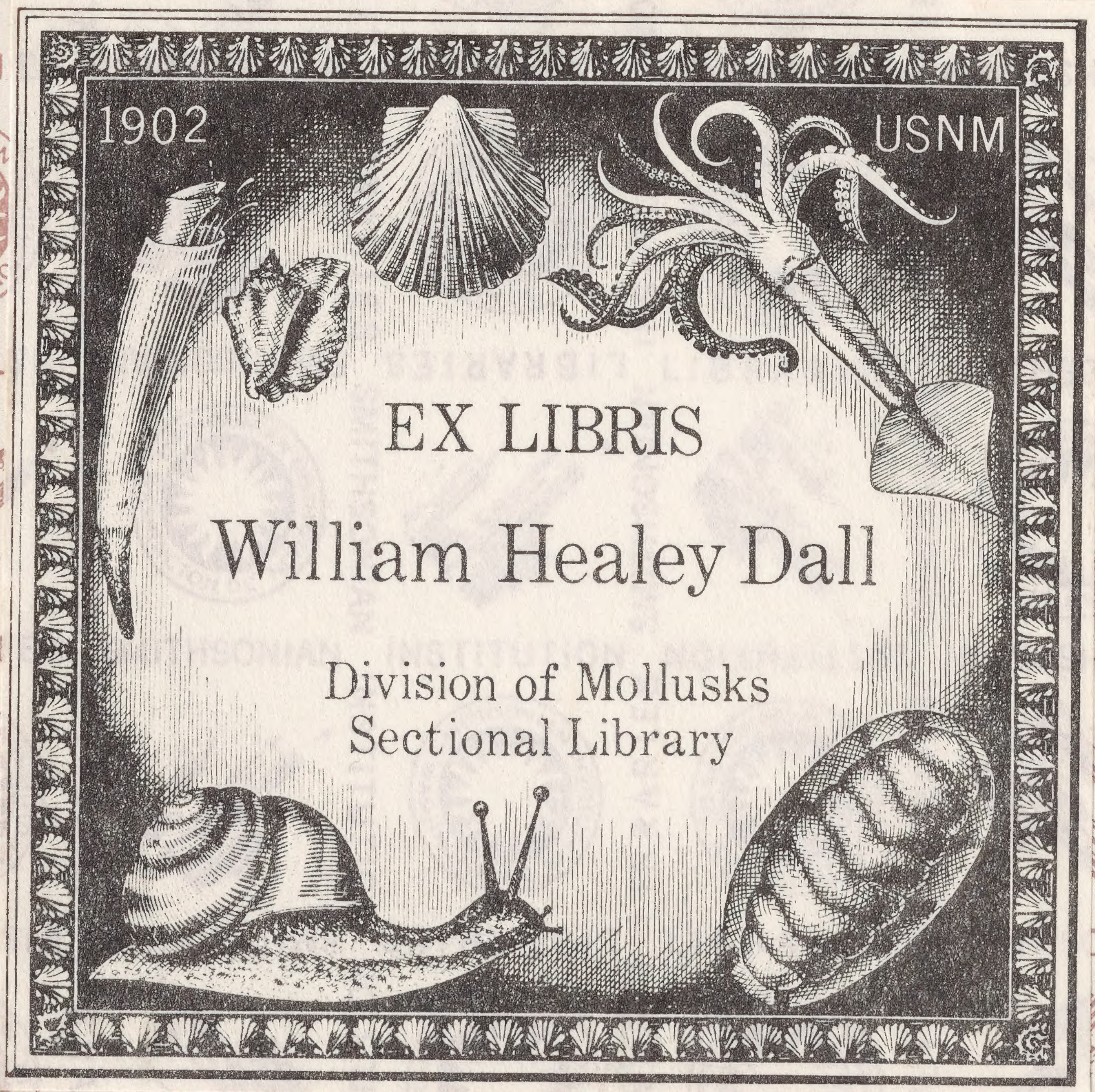

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THE

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(Founded 1874)

BEING THE ORGAN OF THE

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OF
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EDITED, UNDER THE DIRECTION OF THE COUNCIL,

BY

NORA F. McMILLAN, M.R.I.A.

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The Journal of Conchology

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OBITUARY

MRS. ELSIE M. MOREHOUSE
(1884–1969)

Mrs. Morehouse died on 16 March 1969 and conchologists have lost a staunch friend and an indefatigable worker.

Mrs. Morehouse was born Elsie May Andrews on 1 May 1884 at Hints, near Tamworth, but came to Doncaster four years later. In 1908 she married John William Morehouse and spent the rest of her long life in Doncaster. Her interest in the Mollusca began in the early nineteen-twenties and she was helped and encouraged by the late Ernest Stainton. Soon after this she joined the Yorkshire Conchological Society which then met in the home of Mr. Gregory in Leeds, Mrs. Morehouse and her schoolgirl daughter being the only female "conks" (her convenient abbreviation for conchologists) present.

She was also a member of the Yorkshire Naturalists' Union and did a great deal of work for that body, especially in supplying for many years a conchological report of each field-meeting (published in the *Naturalist*). Her forte was certainly field-work and it grieved her that most of her vigorous field-work was accomplished just too early for her records to be included in the current 10-km. square map-census now being conducted by the Conchological Society (which she had joined in April 1927).

Mrs. Morehouse was a good general conchologist but never specialized much; her large collection is now in the hands of her only child, Miss Kathleen Morehouse, B.Sc., M.I.Biol., herself a biologist. Nor did she publish much, only a few notes in the *J. Conch.* and the Y.N.U. conchological reports already mentioned, but her warm personality and regular attendances at meetings made her many friends and her cheerful presence will be much missed.

NORA F. McMILLAN

J. Conch. *27*: 3–8 (1969)

THE DISTRIBUTION OF *CEPAEA* IN SCOTLAND

J. S. Jones and B. C. Clarke

Department of Zoology, West Mains Road, Edinburgh 9

(*Read before the Society, 20 January 1968*)

During the past three years we have been studying the population genetics of the polymorphic land-snail *Cepaea nemoralis* (L.) at the northern limits of its range in Scotland. In the course of our work we have prepared maps of the Scottish distribution of *C. nemoralis* and of its close relative *Cepaea hortensis* (Müll.). These maps (see Figs. 1 and 2) have been compiled from a number of sources:

(1) We have examined complete runs of the following journals:
- The Journal of Conchology.
- The Proceedings of the Malacological Society of London.
- The Proceedings of the Royal Physical Society of Edinburgh.
- The Scottish Naturalist.
- The Transactions of the Banffshire Field Club.
- The Transactions of the Stirling Natural History and Archaeological Society.
- The Transactions and Journal of Proceedings of the Dumfries and Galloway Antiquarian and Natural History Society.
- The Transactions and Proceedings of the Natural History Society of Glasgow (*continued as* The Glasgow Naturalist).
- The Transactions and Proceedings of the Perthshire Society of Natural Science.
- The Zoologist.

(2) We have corresponded with several Scottish conchologists, and have examined the collections of *Cepaea* in the Royal Scottish Museum and at the Nature Conservancy's Edinburgh office.

(3) With the help of members of Edinburgh University Biological Society and York University Biology Society we have collected about 15,000 specimens of *Cepaea* in Forfar, Kincardine, Aberdeen South, Aberdeen North, Banff, Elgin, Easterness, Westerness, Main Argyll, Ebudes North, Ross West, Ross East, and Sutherland West.

It is probable that some of the earlier distribution records are inaccurate. Roebuck (1917), for example, has shown that Gordon's (1839) description of *C. nemoralis* at Burghead (Elgin) is in fact a mistaken identification of black-lipped *C. hortensis*. Because of such uncertainties, we have attempted to re-examine all the most northerly localities from which *C. nemoralis* has been recorded. Where necessary we have dissected out the mucous glands and darts of individual

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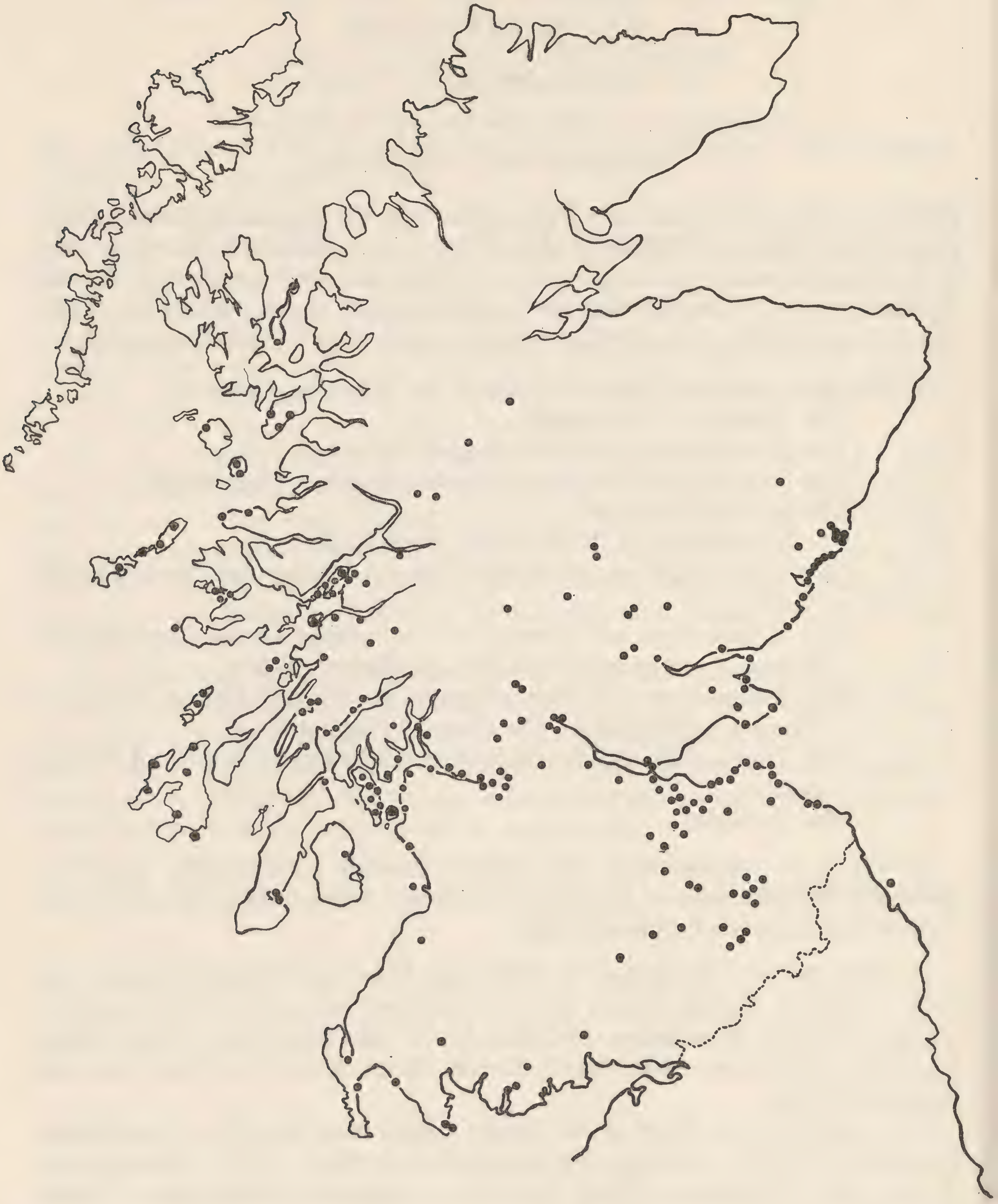

Fig. 1. Records of *Cepaea nemoralis* (L.) in Scotland.

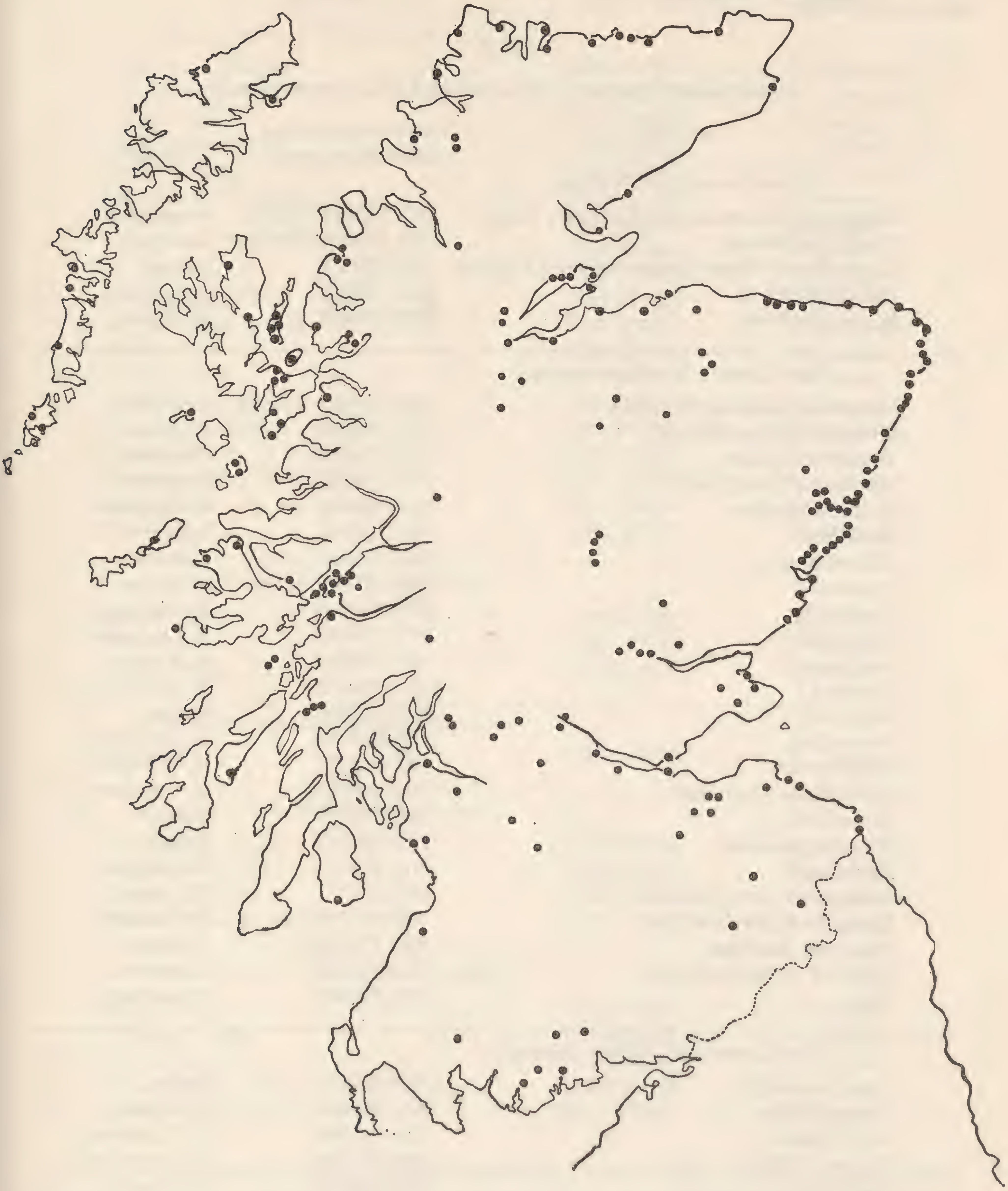

Fig. 2. Records of *Cepaea hortensis* (Müll.) in Scotland.

snails in order to establish their specific identity. The results of this survey are shown in Table 1.

TABLE 1

CONFIRMED NORTHERLY RECORDS OF CEPAEA NEMORALIS (L.)

LOCALITY	ORDNANCE SURVEY GRID REFERENCE	DENSITY
VICE-COUNTY 90 (FORFAR)		
Montrose, Charleton and Kinnaber Links	NO 722568–743626	Abundant
North Esk Mouth	NO 730620–740630	Common
Lower North Water Bridge Railway Viaduct	NO 725622	Sparse
Fisherhills Farm	NO 730622	Common
Waterside Farm	NO 730628	V. Sparse
VICE-COUNTY 91 (KINCARDINE)		
Heughs & Sands of St. Cyrus	NO 739625–754646	Abundant
Kirkside Fishing Station	NO 742633	V. Sparse
Woodston Fishery	NO 756648	Common
Woodston Cave Point	NO 759648	Common.
Kaim of Mathers	NO 764649	F. Common
Rock Hall	NO 766647	Sparse
Milton Ness	NO 771647	Common
Tangleha'	NO 771649	V. Sparse
Denfinella	NO 776656	F. Common
Seagreens 1	NO 779658	F. Common
Seagreens 2	NO 784664	V. Sparse
Narrows 1	NO 786665	F. Common
Narrows 2	NO 790666	Sparse
Bervie Bay	NO 833723	F. Common
Kinghornie	NO 836727	F. Common
Dendoldrum Junction	NO 822727	F. Common
Craigdavid	NO 842731	Sparse
Pitcarry Junction	NO 828737	Sparse
Millplough	NO 814749	Abundant
Kirkcorner Cross Roads	NO 854751	V. Sparse
Kinneff—Catterline Road	NO 857755	F. Common
Parkneuk Junction	NO 793758	Common
Cotbank of Barras Quarry	NO 821790	Common
Birse	NO 558969	Abundant
VICE-COUNTY 89 (PERTH NORTH)		
Glen Fincastle	NN 867617	Sparse
Greag Odhar	NN 869640	V. Sparse
Blair Atholl	NN 891644	F. Common
Bridge of Tilt	NN 877655	F. Common
Blair Castle	NN 865656	V. Sparse
VICE-COUNTY 96 (EASTERNESS)		
Foyers	NH 499206	V. Sparse

LOCALITY	ORDINANCE SURVEY GRID REFERENCE	DENSITY
VICE-COUNTY 98 (MAIN ARGYLL)		
Barsloinach Farm	NR 811957	F. Common
Kilmartin Burn	NR 842965	F. Common
Achnacroish	NM 848402	Common
Loch Balnagowan	NM 856427	V. Sparse
Cachildrishaig	NM 884443	F. Common
Lismore North Point	NM 893464	Common
Seabank	NM 909415	Abundant
Eriska	NM 894424	Abundant
Creagan Inn	NM 978442	V. Sparse
Blarchasgaig Farm	NM 941456	Sparse
Strath Appin School	NM 938460	F. Common
Dalnasheen	NM 916460	Abundant
Loch Laich	NM 923465	Common
Loch Creran	NN 008461	Common
Eilean na Caorach	NM 900468	F. Common
Glenstockdale 1	NM 942483	Abundant
Glenstockdale 2	NM 943487	Abundant
Glen Coe 1	NN 104584	Sparse
Glen Coe 2	NN 106589	V. Sparse
VICE-COUNTY 97 (WESTERNESS)		
Sanna Bay	NM 443685	Abundant
Kilmory	NM 525708	V. Sparse
Spean Bridge	NN 243817	Sparse
VICE-COUNTY 102 (EBUDES SOUTH)		
Colonsay	NR 399978	F. Common
VICE-COUNTY 103 (EBUDES MID)		
Cornaigbeg (Coll)	NM 249635	F. Common
Hogh Bay (Coll)	NM 165572	V. Sparse
Crossapol (Coll)	NM 145533	Abundant
Port a'Mhurain (Coll)	NM 118512	Abundant
VICE-COUNTY 104 (EBUDES NORTH)		
Laig (Eigg)	NM 467877	V. Sparse
Ardvasar (Skye)	NG 627026	V. Sparse
Ord (Skye)	NG 624132	V. Sparse
Ostaig House (Skye)	NG 650058	Sparse
Eyre Point (Raasay)	NG 579342	V. Sparse

We have confirmed Taylor's (1853) record of *C. nemoralis* at Birse (Kincardine), Roebuck's (1891) record at Foyers, on Loch Ness, and Heslop-Harrison's (1937) on Raasay. We have not yet had the opportunity to confirm the last author's record for South Rona. At its northern limits, *C. nemoralis* shows rather less association with patches of limestone than might be expected from Boycott's

(1934) description of *nemoralis* as "a species which prefers a calcareous habitat, especially under adverse climatic or topographical conditions." The apparent correspondence of the northern limits with summer isotherms (Cain and Currey, 1963) is also less marked than might at first appear.

We intend to continue work on populations of *C. nemoralis* and *C. hortensis*, and would be very grateful for further information on the distribution of these species in Scotland. We would particularly welcome accurately-located random samples.

ACKNOWLEDGEMENTS

We are very grateful to the following, either for sending us collections of *Cepaea*, or for allowing us to use their own records: D. Briscoe, Esq.; J. B. Coutts, Esq. and members of the Northern Naturalists Club; Dr. A. Cruickshank; G. Dorian, Esq.; Dr. A. F. Dyer; H. Ford, Esq.; T. Huxley, Esq.; Dr. M. P. Kerney; D. K. Kevan, Esq.; E. J. Lees, Esq.; Mrs. N. F. McMillan; Dr. D. Parkin; Dr. D. Pomeroy; Mrs. E. Rutherford; T. Warwick, Esq. and A. R. Waterston, Esq., O.B.E.

We are also much indebted to the members of the Edinburgh University Biological Society and the York University Biology Society who took part in the expeditions which were responsible for the majority of the records quoted in this paper. In particular we should mention Mr. and Mrs. T. H. Day; J. Gordon, Esq.; P. H. Harvey Esq. and H. G. Smith, Esq. Miss L. Stewart skilfully drew the figures.

We are very grateful to the Universities of Edinburgh and York, the Science Research Council, the Carnegie Trust for the Universities of Scotland, and the Nature Conservancy for financial help.

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J. Conch. *27*: 9–10 (1969)

DAYTIME RESTING SITES OF *AGRIOLIMAX RETICULATUS* (MÜLLER) IN WOODLAND

Dennis Pallant

Beverley Grammar School, Beverley, Yorks.

(*Read before the Society 18 May 1968*)

Kühnelt (1961) quotes E. Frömming as pointing out that slugs and snails are generally absent from broadleaf forests lacking a ground cover, and it has been shown that herbs form the principal food of *Agriolimax reticulatus* (Müller) in woods (Pallant, 1967). I have also generally observed in daytime collecting that slugs are not found in areas of woodland lacking a herb layer although there may be no lack of suitable refuges in the form of fallen wood, leaf litter and loose soil. A survey was made using a class of 14 to 15 year-old boys as observers. The boys searched under fallen wood, recorded the presence or absence of slugs and other animals and the proximity of herbs to the logs. To avoid duplication of observations and to investigate different regions of the wood each boy searched a definite area. Logs lying distant from a ground cover for 1 yard in every direction were listed as distant from herbs, and were compared with logs lying on or nearer to a herb layer. Forty logs of each category were investigated during the course of an afternoon.

The woodland investigated has a mixed tree layer, but this is predominantly Oak (*Quercus robur* L.), with frequent Holly (*Ilex aquifolium* L.) and occasional Beech (*Fagus sylvatica* L.), Ash (*Fraxinus excelsior* L.), Birch (*Betula pendula* Ehrh.) and others. It is about a quarter mile square and lies at about 150 feet above sea level on boulder clay overlying chalk. Other species of slug found in the wood include *Arion intermedius* Normand, *Arion fasciatus* (Nilsson) (agg.), *Arion hortensis* Férussac, and *Arion ater ater* (L.) but *Agriolimax reticulatus* is the most common species and was the only one found in the present study. The study was made in late September 1964.

The table shows the total number of logs of each category underneath which the different groups of animals were found. It is seen that eight logs near herbs had slugs present and three others had slug's eggs, almost certainly those of *A. reticulatus*. None of the logs distant from herbs had either slugs or eggs present. The other groups of animals, however, appear to be nearly equally distributed between the two categories of logs.

Statistical analysis shows that there is a significant association between resting site of slugs and the presence of a herb layer.

South (1965) found *A. reticulatus* distribution on pasture to be associated with Cocksfoot grass tufts (*Dactylis glomerata* L.) and suggested that this could be

TABLE

Numbers of logs near to and distant from herbs under which different kinds of animals were found in woodland.

Animal Type	Logs Near Herbs	Logs Distant from Herbs
Earwigs	2	2
Earthworms	8	3
Beetles	10	7
Flies	23	19
Centipedes	4	3
Millipedes	7	8
Spiders	16	13
Woodlice	15	12
A. reticulatus	8	0
Slug's eggs	3	0

largely due to the provision of shelter by the tufts. Barnes and Weil (1945) and Boycott (1934) concluded that food is unlikely to be an important factor in determining the distribution of slugs other than the Testacellidae. The present study suggests that in woodland the presence of food in the form of a herb layer might determine distribution on a broad scale. It seems probable that in rough woodland there will be more than adequate shelter available to slugs in the form of fallen wood, leaf litter and loose soil apart from that provided by vegetation thus reducing the importance of this factor.

This forms part of an M.Sc. thesis presented to Durham University.

ACKNOWLEDGMENTS

I would like to thank Dr. Lewis Davies and The Royal Society Committee for Scientific Research in Schools, Dr. J. H. Sudd for statistical advice, and the boys of Form 4A at Beverley Grammar School, 1964–5, for making the collections.

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J. Conch. *27*: 11–12 (1969)

MARPESSA LAMINATA (MONTAGU) BRED IN A SMALL BOX FOR FIFTY-FOUR YEARS

A. W. Stelfox
21 Tullybrannigan Road, Newcastle, Co. Down, Northern Ireland

(*Read before the Society, 18 May 1968*)

On 30 June 1914 I received from Dr. J. Wilfred Jackson four living adult white-shelled specimens of this species, which he had just collected in Cranham Woods, Gloucestershire. These I placed in one of my breeding boxes, which are 8 inches by 6 inches by about 4 inches in depth with one inch or less of sand and covered by a sheet of glass.

At the beginning of my attempt to breed snails in 1909 they were fed every few days on lettuce and chopped carrots, but as this food gave too much trouble to keep fresh, I soon changed to a supply of flake oat-meal sprinkled on a damp cabbage leaf and I suspect that by 1914 the changeover had already been introduced. At any rate it is safe to state that for over fifty years these *M. laminata* have successfully bred and flourished, while the present generation are approximately the same in size and shape as the wild specimens received from Dr. Jackson in June 1914. I must also explain that from October of one year, until February or March of the next year no food or water was supplied to the snails.

As the *M. laminata* were allowed to breed just as they pleased, for the most part, and one generation overlapped the next, or perhaps the next three, I have absolutely no idea how many generations have come and gone since 1914.

One individual born on 28 June 1914 was full grown on 25 April 1916! There could have been a generation, therefore, at least every two years or even possibly every year in some cases, but in one instance at least there was a gap from 1917 until 1922 when no young were seen in the box.

I will now give particulars relating to this gap from my notes. They are as follows: "On 19 July 1917 all in the box were removed and killed except two adults—one whose shell was brown and the other's white. On 20 June 1918 that with the brown shell was found dead, while the white—now at least several years old—was alive and well. On 10 May 1922 it was still alive and healthy. In June 1922 one young pale specimen was observed in the box and on 19 August 1922 three ¼-grown were discovered, while on 1 October 1922 eight were counted, several of whose shells were turning brown, while the shell of the largest—now about half grown—was rich brown."

So far as I am aware—and my notes confirm this—there was no possibility of the white-shelled specimen having mated since the death of its brown-shelled partner in 1918. If correct, this means that since it may have mated at least four years had gone by.

And here I must digress! Assuming, as is customary in all the snails which

I have bred, that the white-shelled form—if such occurred—was recessive to the normal brown, therefore one at least of the four white adults sent to me in 1914 must have mated with a brown individual before it was collected by Dr. Jackson, as the Fl generation consisted of both brown and white-shelled specimens. Unless, however, the white-shelled specimen which produced young in 1922 had remained fertile for four years after its partner had died, it is difficult to believe that white is recessive to brown. If the pale young born in 1922 and which subsequently turned brown were produced from parthenogenetically fertilized eggs, then it would seem that white must be dominant to brown—yet I do not believe this is so. Hence to me the whole matter is a mystery and I must leave others to form their own opinion.

During this long period from 1914 I have never seen two attempt to mate, found eggs nor discovered where they were laid. Moreover, the young generally have appeared in the breeding box in very small numbers at a time. Sometimes only one or two were seen. The young have appeared all through the summer months, from April onwards, and I have many times wondered if the species could be ovoviviparous, like *Balea*, and I understand *Laciniaria biplicata*, but I have never seen any suggestion that *Marpessa laminata* possessed this habit.

Only in one very hot and dry period have I any note of young appearing in quantity. On this occasion—July–August 1955—there may have been at least twenty adults in the box and all producing young—and my note reads as follows: "Many young found on 25 July 1955 and very many by 2 August, after a month of great heat and drought."

The smallest young which I have examined are about the size of a large *Vertigo* and possess about three whorls. The brown and white-shelled forms continue to appear in approximately equal numbers, but I have never actually counted them because of the overlapping of the generations.

In several seasons I have seen specimens of an intermediate colour—a pale lilac-brown—which I have assumed were a hybrid between the normal dark brown and the white forms.

J. Conch. *27*: 13–14 (1969)

A NOTE ON THE VALIDITY OF *SUBULINA GRANDIS* MADGE

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(*Read before the Society, 14 Dec. 1968*)

Subulina striatella (Rang) is a very common snail in the hot-houses at Kew and is remarkably successful and prolific. It has been reared by Miss P. Halliday and one particular specimen, which was probably over a year old when found in the hot-houses, eventually died about a year later measuring 31 mm. high and 7 mm. wide. This is considerably longer than any of those I have seen in the houses and has helped solve a problem.

In 1938 E. H. Madge (1938, p. 20) described *Subulina grandis* from Mauritius, his type measuring 32·5 mm. high and 7 mm. wide, and largest specimens 42 mm. high. It seemed curious that such a large shell had previously escaped notice in Mauritius. He compared his specimens with *Subulina striatella* and stated they closely resemble that species. The material of that species in the British Museum (Natural History) ranges from 20–26 mm. long and 4·5–6·5 mm. wide. Pilsbry (1906, 75–78) gave measurements of the specimens he had seen as 16–18·5 mm. tall, and 4 mm. wide. He has access to some hundreds of specimens from Cape Palmas, Liberia, Senegal and Prince's Island, and I have seen large numbers at Kew, variable in size but mostly measuring about the same as those in the British Museum. The large specimen kept in captivity shows that Madge's supposed species cannot be maintained and that its presence on the island is due to an introduction; the specimens undoubtedly found themselves in a very favourable environment, actually under a stone in an absorption pit. I have compared the specimen with Madge's holotype and three paratypes preserved in the British Museum (Natural History) and there is no doubt as to their identity. At the time of Madge's paper it was not well known that the species was a wanderer although I suspect that many so-called *Subulina octona* reported from Kew this century should be referred to *Subulina striatella*. I was also sent a fairly small specimen from Cerf Island, Seychelles by G. Lionnet in 1958. This record fits in with the general pattern. The synonymy is formally proposed below; I have omitted the detailed synonymy very adequately set out by Pilsbry.

Subulina striatella (Rang, 1831)

1831 *Helix striatella* Rang, *Ann. des Sci. nat.* **24**: 38, pl. 3, f. 7.

1906 *Subulina striatella* (Rang). Pilsbry, *Manual of Conchology* **18** : 75, p. 11, f. 89–92.
1938 *Subulina grandis* Madge, *Mauritius Inst. Bull.* **1**(3) : p. 3, f. 7.

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J. Conch. 27: 15–16 (1969)

A SPECIES OF *GULELLA* PFR. (STREPTAXIDAE) INTRODUCED INTO BRITAIN

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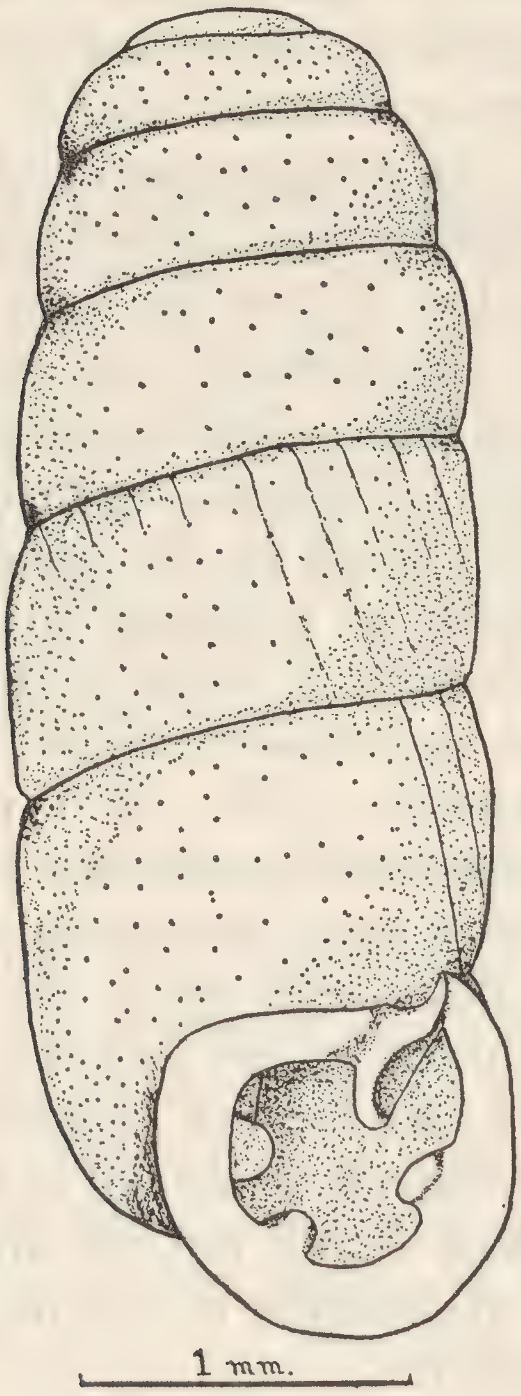
(*Read before the Society, 16 March 1968*)



In 1967 Mr. J. Armitage of the Leeds Museum handed over to me for identification a series of molluscs collected in the hot-houses at the Royal Botanic Gardens, Kew. Reports on the wild fauna and flora of Kew have been published in a series of papers appearing in the Bulletin of Miscellaneous Information, Kew and subsequently in the Kew Bulletin during the past eighty years. Details of the most recent collection will form part of a further report in this series but it seemed advisable to publish a separate brief account concerning one record of special interest.

Under a stone on the central display bank in the Aroid House (House No. 1), Mr. A. Norris (who accompanied Mr. J. Armitage on his collecting expedition) found a single specimen of a small *Gulella* measuring 4·0 mm. long and 1·4 mm. wide. Species of this genus are very abundant in Tropical and South Africa, several hundred species having been described; they also occur in Asia and on many of the islands in the Indian Ocean. Only one other report has been found in the literature concerning a previous occurrence of a species of this genus in hot-houses in this country. I made a further search in House 1 myself to attempt to find more material, but in vain—only the usual denizens of this particular house were discovered, namely the abundant *Subulina striatella* (Rang) (usually misidentified as *S. octona*), *Zonitoides arboreus* (Say) and *Agriolimax laevis* (Müll.). Attempts to name this *Gulella* have failed entirely and, of course, the lack of data concerning the country of origin is a serious hindrance. Despite a definite "African facies" the shell does not agree with any species known to me from Tropical Africa, neither has Dr. A. C. van Bruggen been able to match it with any of the South African species. The shell is small, cylindrical, imperforate, white, shining and practically devoid of sculpture save for some slender transverse costae on the back of the body whorl; the apex is very obtuse; there are 7 rather flat whorls; the aperture is rounded with a thick peristome and bears a strong parietal lamella, smaller denticles on the outer and columella walls (one just to either side of the base) and an immersed process on the columella. A sketch of the shell is given which should render it easy to recognise further specimens. The species to which it bears closest resemblance is *G. devia* Connolly but that has the parietal lamella in a mid-position and the denticle on the outer lip is definitely situated higher up the lip. When Connolly (1931 : 310, pl. 10, fig. 10) described this species from material collected on the Uganda side of Mount Elgon by G. D. Hale Carpenter, he also ascribed to it some specimens collected in the hot-houses of the Royal Botanic Garden, Edinburgh by A. R. Waterston. Mr. D. Heppell has kindly loaned these specimens to me and they undoubtedly belong to the same species as the Kew shell and are not identical with the type of *G. devia*. It is very probably a new species and it would not be the first animal to be described from the Kew hot-houses which is still not yet known in its native habitat. It would, however, be unwise to describe a *Gulella* from a few shells when its country of origin is not yet known.

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J. Conch. 27: 17–24 (1969)

VITREA DIAPHANA (STUDER) IN BRITAIN

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(*Read before the Society, 16 March 1968*)

1. *Introduction*

On 29 May 1966 one of us (M.F.) collected some specimens of *Vitrea* in Oxenber Wood, Austwick, in the Craven district of west Yorkshire. Among normal *Vitrea contracta* (Westerlund), were two empty shells here ascribed to *Vitrea diaphana* (Studer), an alpine species not hitherto detected in Britain. Further visits to Oxenber Wood and to some other habitats close by between July 1966 and May 1967 resulted in the discovery of more examples of this species, some alive.

In July 1967 Mr. L. W. Stratton sent for examination some *Vitrea* collected in 1955 in Tarn House Wood, Malham, west Yorkshire. Among them were two further examples of *Vitrea diaphana*.

2. *The Yorkshire sites*

Oxenber Wood (NGR SD/778683) lies approximately one mile east of the village of Austwick, on the steep southern and western slopes of Oxenber Hill, an upstanding mass of Carboniferous limestone rising to over 900 feet. About 750 feet the hillside is quite thickly wooded, but the trees thin out higher up giving place to outcrops of limestone. The trees are principally hazel (*Corylus avellana* L.), with some rowan (*Sorbus aucuparia* L.), hawthorn (*Crataegus* sp.) and sycamore (*Acer pseudoplatanus* L.) (the plant ecology of similar woods in the Craven area is fully described by Tansley (1939: chapter 21)). Among the trees are numerous blocks of moss-covered limestone, presumably fallen from the outcrops above, and around these are pockets of leaves. Most of the examples of *Vitrea diaphana* were found here, under stones and dead leaves.

The following species were recorded in Oxenber Wood in 1966 and 1967:

Carychium tridentatum (Risso)
Cochlicopa lubrica (Müller)
Cochlicopa lubricella (Porro)
Pyramidula ruperestris (Draparnaud)
Lauria cylindracea (da Costa)
Abida secale (Draparnaud)
Acanthinula aculeata (Müller)
Ena obscura (Müller)
Marpessa laminata (Montagu)
Clausilia bidentata (Ström)

Arianta arbustorum (Linné)
Helix hortensis Müller
Hygromia striolata (C. Pfeiffer)
Hygromia hispida (Linné)
Discus rotundatus (Müller)
Arion intermedius Normand
Arion circumscriptus Johnston
Arion hortensis Férussac
Arion ater (Linné)
Euconulus fulvus (Müller)
Vitrea diaphana (Studer) (10 examples)
Vitrea crystallina (Müller) (>17 examples)
Vitrea contracta (Westerlund) (>23 examples)
Oxychilus cellarius (Müller)
Oxychilus alliarius (Miller)
Retinella radiatula (Alder)
Retinella pura (Alder)
Retinella nitidula (Draparnaud)
Vitrina pellucida (Müller)
Agriolimax reticulatus (Müller)

In May 1967 *Vitrea diaphana* was found at two further sites a little further to the east: Feizor Wood (SD/788681) and Stockdale Fell (SD/790682). Feizor

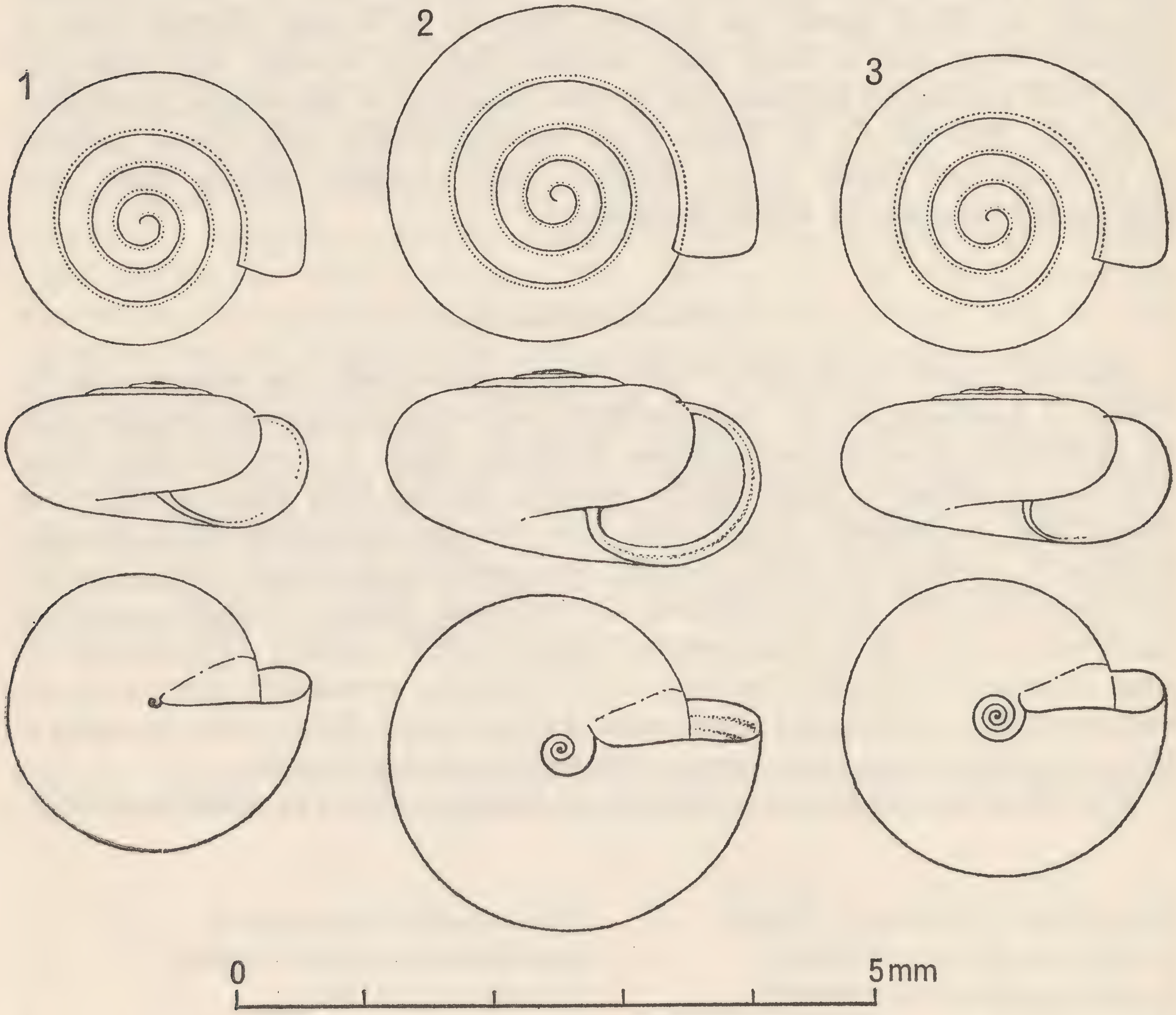

Fig. 1 to 3. *Vitrea* from Oxenber Wood, near Austwick, Yorkshire, coll. Marjorie Fogan, 1966–67. 1, *V. diaphana* (Studer), form *subrimata* (Reinhardt); 2, *V. crystallina* (Müller); 3, *V. contracta* (Westerlund).

Wood lies on the eastern side of Oxenber Hill. It is largely composed of sycamore (*Acer pseudoplatanus*), and is more sheltered than Oxenber Wood and the limestone outcrops are more moss-grown. A single example of *Vitrea diaphana* was found after a brief search. The fauna closely resembles that of Oxenber Wood, with the addition of *Vallonia excentrica* Sterki, *Balea perversa* (Linné) and *Punctum pygmaeum* (Draparnaud). Stockdale Fell faces Feizor Wood across a small valley which runs southwards to Feizor village. The site is different in character from the previous two; it is a hillside covered with short grass grazed by sheep, interrupted by outcrops of limestone. Fallen rocks of various sizes lie upon the slopes, and the Mollusca, including four examples of *Vitrea diaphana*, were around and beneath these rocks. The association of species is, however, not dissimilar to that at the other sites, although of a somewhat more xerophile character; *Abida secale* and *Pyramidula rupestris* are commoner and found in close association with the *Vitrea*, whereas at Oxenber Hill these species tend to be restricted to the higher parts of the limestone outcrops where the trees become sparse.

Tarn House Wood (SD/8967) lies along the northern edge of Malham Tarn, eight miles due east of Austwick. It is a rather thin, open wood, of mixed deciduous and coniferous trees, lying between about 1,250 and 1,400 feet on the scree-slopes below the Carboniferous limestone crags of Highfolds Scar. Although here and there modified by planting, it is essentially natural in origin and is likely never to have been clear-felled. The molluscan fauna is a fairly rich one and includes *Oxychilus helveticus* (Blum), very local in this part of England (Stratton, 1957 : 117; personal communication). The *Vitrea* received from Mr. Stratton, collected by him in 1955, comprised *V. diaphana* (2 examples), *V. crystallina* (5 examples) and *V. contracta* (1 example).

3. *The British species of* Vitrea

Typical specimens of the three species of *Vitrea* found in Oxenber Wood are here illustrated by camera lucida drawings (Figures 1 to 3). The two commonest are *V. crystallina* and *V. contracta*, which exhibit the differences illustrated and listed by Kuiper (1964) : *V. contracta*, although the more closely-coiled species, has the more open umbilicus—a symmetrically-conical cavity which allows the inner whorls to be seen clearly almost to the apex (Figure 3). The base of the shell is also more flattened than in *V. crystallina*, and the aperture lacks the internal rib which develops in mature shells of that species (compare Figures 2 and 3).

Since 1951, when the occurrence in Britain of *V. contracta* as a species distinct from *V. crystallina* was pointed out by Ellis, the ecology and distribution of the two species has become much better known. Both are common in suitable habitats throughout the greater part of the British Isles, with the exception of the northernmost parts of Scotland, where *V. contracta* is more frequent than *V. crystallina*. In the Orkneys and Shetlands, *V. contracta* has so far been recorded from no fewer than thirteen 10-kilometre squares, while *V. crystallina* is known from a single locus only (Stromness, Orkney). Such a distribution is in keeping with the situation in Scandinavia, where *V. contracta* has the more northerly range (Økland, 1925; Waldén, 1955). In lowland Britain *V. crystallina* is, however, probably the more widespread species. It is characteristic of moderately humid environments, such as marshes, damp meadowland, and grassy roadside verges, and is tolerant of oligotrophic conditions, such as the margins of peat bogs. *V. contracta*, on the other hand, requires drier and more eutrophic habitats. It occurs commonly in calcareous grassland and woodland, and may live in screes, or on walls. *Cochlicopa lubricella* is a characteristic associate. But there is considerable overlap between the kinds of places these species will tolerate, and they are quite often found together in chalk or limestone woods, as at Austwick and Malham.

The third species at Oxenber Wood (Figure 1) may readily be distinguished by its minute, almost occluded umbilicus, quite unlike the relatively open umbilicus seen in the other two species. In size and general proportions the shell is similar to that of *V. contracta*: the largest measures 2·3 mm. × 1·25 mm. In mature examples the peristome is very slightly thickened internally, but never so strongly as in *V. crystallina*. This third species is identical with *V. subrimata* (Reinhardt, 1871). But it is doubtful whether this form can be considered specifically distinct from *V. diaphana* (Studer, 1820), of which it is considered a variety by Mermod (1926), Germain (1930) and Riedel (1957). It differs solely in possessing an umbilical perforation, whereas typical *V. diaphana* has a closed umbilicus (Pintér, 1968, Figures 13 to 15; for the type of *V. diaphana* see Forcart, 1957).

4. *Taxonomic status of* Vitrea subrimata

The distributions of *V. diaphana* (seg.) and *V. subrimata* are similar, and may be broadly characterized as Alpine–Carpathian–south European. But they are not identical. For example, *Vitrea subrimata* occurs in Switzerland to the virtual exclusion of *V. diaphana*, and in the Alps reaches great altitudes, commonly living between 2,200 and 2,400 metres (Mermod, 1930), and recorded as high as 2,700 metres (Zilch and Jaeckel, 1962). In the Swiss Jura, only *V. subrimata* is known (Favre, 1927), and one of us (M.K.) has collected it in several places in the French Jura (e.g., Montagne du Grand Columbier, Ain). In Germany, *V. diaphana* occurs somewhat beyond the range of *V. subrimata* to the north (Ehrmann, 1933; Ant, 1963). In the mountains of the Polish Carpathians both forms occur, but only *V. diaphana* is known from the lower hilly country of the Polish Jura (Riedel, 1957).

The ecology of the two forms differs somewhat. *V. diaphana* is described by Germain (1930: 160) as "Espèce hygrophile vivant parmi les mousses humides, au bord des fossés et des fontaines, dans les troncs pourris, parmi les éboulis", whilst the var. *subrimata* is described as "Forme sylvicole moins hygrophile que le type, vivant sur les écorces, les blocs de roches moussus, sur les pierres humides, parmi les feuilles mortes", and Favre (1927: 187) adds "Il ne craint pas les stations sèches et chaudes, aussi le trouve-t-on dans presques toutes les garides". In central and eastern Europe this pattern seems to be repeated, with *V. diaphana* commonest on the lower hillsides and *V. subrimata* more characteristic of mountain woods, especially on scree-slopes at high altitudes (Ložek, 1964; Pintér, 1968).

Such facts bear two interpretations. It might be that *V. diaphana* and *V. subrimata* are indeed separate species, with distinct ecological preferences. However, if this were so, one would expect in some places to find mixtures of the two species with each sharply retaining its morphological identity, as we do with *Cochlicopa lubrica* and *C. lubricella*, or with *Vitrea crystallina* and *V. contracta*. But this seems not to occur; instead these forms tend to occupy different areas within a broadly similar European range, *V. diaphana* giving place to *V. subrimata* wherever hills become mountains, the country becomes drier and more exposed, and sheltered valleys give way to wooded screes with bare rocks. The observation that in Hungary the two forms are found only as unmixed populations (Pintér, 1968: 179) is indeed an argument for their specific identity rather than for their separateness. On this view, the umbilicate *V. subrimata* seems more likely to be a variant developed by an environmental stimulus, and to have no greater claim to be a distinct species than, for example, the small conical var. *alpicola* Férussac of *Arianta arbustorum*, which above certain elevations in the

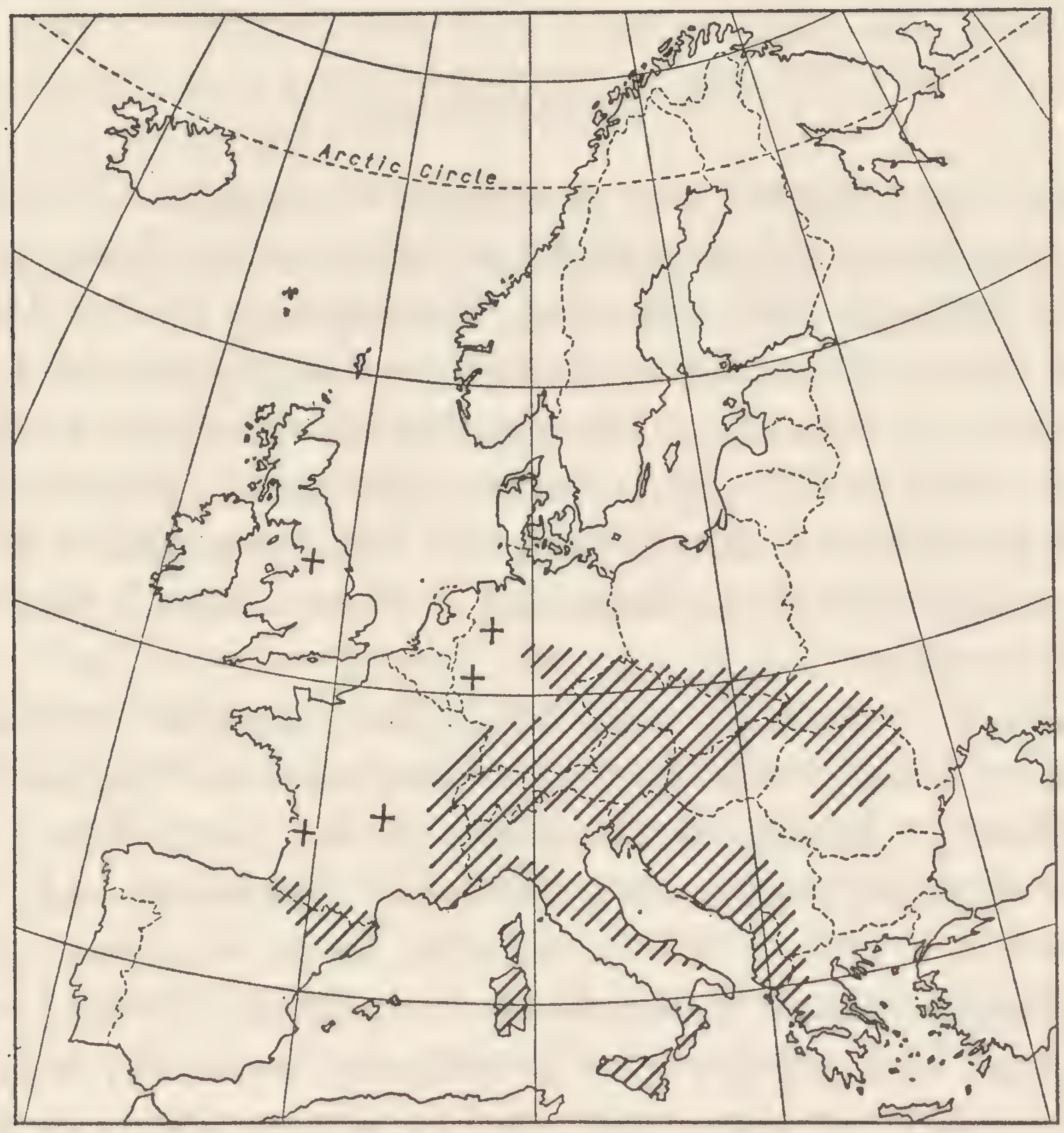

Fig. 4. Approximate geographical range of *Vitrea diaphana*, compiled from published sources. Crosses represent isolated stations or small groups of stations.

Pyrenees, Alps and Juras (Germain, 1930 : 227) regularly replaces the normal form of the species.

In conclusion, it may be observed that Riedel (1957) has shown that Polish *V. subrimata* and *V. diaphana* do not differ anatomically, and he considers that the conchological distinction scarcely merits taxonomic recognition, even at subspecific level. Focart (1965 : 96) accepts this view, and treats both umbilicate and non-umbilicate shells from southern Italy as a single species, to which he applies the earlier name *diaphana*. A similar view is tentatively adopted in the present paper.

5. *Zoogeography*

Figure 4 shows the approximate geographical range of *Vitrea diaphana* (including *V. subrimata*), based on published information (principally Ant, 1963; Ehrmann, 1933; Forcart, 1965; Jaeckel, Klemm and Meise, 1958; and Riedel, 1957). There is some uncertainty about the distribution in France. Moquin-Tandon (1855–56 : 2, 91) gives "les montagnes centrales de la France", and Germain (1930 : 160) says "assez commun, presque partout" and illustrates a shell from Bordeaux (Plate 2, Figures 54–55), but nevertheless it is likely that the species is local outside the Alps, Juras and Pyrenees. and is perhaps absent from the north of the country.

Beyond the main area of distribution in the heart of central Europe, there exist a number of more or less isolated stations, such as those in the Harz Mountains and Teutoburger Forest, in the Rhine Valley near Bonn, and, ultimately, much further to the north-west, the colonies in Yorkshire. All these are clearly relicts of a formerly wider distribution, and, as in all cases of this kind, two questions immediately present themselves: first, at what period was *V. diaphana* able to reach so far into north-west Europe; and secondly, why has the species become generally extinct in this region and in what respect do the relict habitats provide conditions favourable for its survival?

Certain localities in the Pennines, such as Teesdale, have long been famous for plants of mainly arctic/alpine or alpine distribution. Palaeobotanical work has revealed that many of the species concerned were widespread in the English lowlands during the Late Weichselian (Late-glacial) period (ca. 13,000–8,300 B.C.), immediately following the disappearance of the ice-sheets of the Last Glaciation. During the succeeding Post-glacial period such plants were widely exterminated. This was caused, not so much by rising temperatures in themselves, as by the adverse environmental changes which the improvement in climate brought about; consequently, they were able to survive only at a very few sites which, by reason of some local accident of soil or elevation, retained their Late-glacial character. Several such "refuges" are known in the Pennines (for a much fuller discussion, see Godwin, 1956 : 319).

It seems virtually certain that *Vitrea diaphana* is a species with such a history. Its present European distribution is essentially montane. It avoids deep mature soils on level ground, such as gleys and brownearths, and prefers places where the soil cover is thin or broken and bare rock is exposed. It is especially characteristic of screes, whether open or thinly wooded. At the end of the Last Glaciation and in the earliest part of the Post-glacial (Pre-boreal period), conditions favourable to the spread of such a species were widely present in Britain, particularly on chalk or limestones where frost-weathering provided extensive areas of rock waste, here and there lightly covered with woods of birch and juniper. But as the forest cover developed, in the Boreal and Atlantic periods, these habitats quickly disappeared. A continuous mat of vegetation covered and bound the subsoil. Possibly also of importance was a progressive acidification caused by deep leaching, and some sites may have been destroyed by the growth of upland peats, common in the Pennines.

In the case of *Vitrea diaphana* we cannot as yet demonstrate the truth of this hypothesis, as palaeontological evidence is still lacking, but strong support comes from a consideration of the history of *Abida secale* (Kerney, 1962, 1963). *A. secale* has somewhat similar ecological requirements to *Vitrea diaphana*—it lives mainly in broken ground in relatively open habitats. Its present distribution in Britain is markedly discontinuous, but during zones II and III of the Late Weichselian it was much more widespread, and occurred in places where it is now extinct. It is of much interest that *A. secale* is an associate of *V. diaphana* at Austwick, and indeed lives fairly freely throughout the Ingleborough–Settle area. The evidence suggests that both species have survived here continuously throughout the Post-glacial period, because deep soils were never able to develop on the unstable limestone screes, and because local conditions of exposure and steepness allowed thin open woodland to persist and not to be replaced by the deep-rooted heavy forests of the climatic optimum.

It is not unlikely that *V. diaphana* will be found living in other places in this country of the same character, possibly in the climax ash/hazel woods of the Mendip Hills where *Abida secale* is common (Swanton, 1912 : xxxv, Plate 2; Tansley, 1939 : 428); and its fossil occurrence in either Late-glacial or earliest Post-glacial deposits may confidently be expected.

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NOTE ADDED IN PRESS

Specimens of *V. diaphana* were taken by M. Fogan on 30 August 1969 at Scar Close, on the north of Ingleborough Hill (NGR 34753779). *V. crystallina* and *V. contracta* were also present.

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PISIDIUM PSEUDOSPHAERIUM (SCHLESCH) NEW TO IRELAND

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Pisidium pseudosphaerium is among the rarer species of European *Pisidium*. In the British Isles it has been recorded from Pevensey and Ilford, Sussex (Dance, 1955, 1957), Glastonbury, Somerset (Ellis, 1950) and Bromborough, Cheshire (McMillan, 1962). Although doubtless a good deal more widespread than these records suggest, it is certainly uncommon and its distribution must be markedly discontinuous.

At Easter 1968 a small party of members of the Conchological Society visited Ireland. Large collections of *Pisidium* were made at many places along the length of the Royal Canal, which connects Dublin with the River Shannon near Longford town. The canal was constructed in the 1790's and is now disused. *Pisidium pseudosphaerium* was detected in three of the gatherings: from Leixlip, Kildare (Irish National Grid reference N 9936), Moyvally, Kildare (N 7242) and near Killucan, Westmeath (N 5549). Three examples were found at Leixlip, and one from each of the other sites; all were living or freshly dead. I am indebted to Mr. A. W. Stelfox, Mr. S. P. Dance and Mr. J. G. J. Kuiper for kindly confirming the identity of these shells. Whether the apparent scarcity of *P. pseudosphaerium* in the Royal Canal is real or illusory is not clear. At each place collections of *Pisidium* were made along about a hundred yards of the canal and a variety of habitats sampled. It is possible—in fact likely—that the *P. pseudosphaerium* were living only in a circumscribed habitat of a specialized kind, which I did not sample adequately. According to Kuiper (1949) and Dance (1956), *P. pseudosphaerium* is usually restricted to clear, stagnant water in swamps and ditches with much aquatic vegetation. At Leixlip and at Moyvally the canal has indeed in places developed a shallow marginal zone choked with weed, adjacent to the deeper and more open water in the middle, and it may well be that the *P. pseudosphaerium* came from the former zone only. At Killucan the canal had recently been cleaned out. No clearly defined marginal zone was present, and as yet there was very little aquatic vegetation of any kind.

Pisidium milium, *P. subtruncatum* and *P. nitidum* were common at all three sites; in addition, *P. obtusale* was collected at Moyvally and Killucan, and *P. hibernicum* at Moyvally.

On 25 June 1968 I collected some *Pisidium* from the disused Lagan Navigation Canal by Moira station, just inside Co. Antrim (J 1561). I visited this place because it was here that in 1919 Mr. A. W. Stelfox discovered *Pisidium moitessierianum* in abundance, the only known locus for this species in the north of

Ireland. Conditions have altered greatly in the past fifty years. The water is now stagnant, and the bottom is now quite unsuitable for such a "river" species as *P. moitessierianum*, being covered with fetid peaty black mud. The floating vegetation, mainly *Lemna*, carries a fairly rich fauna of freshwater pulmonates, but bivalves, which are principally bottom-livers, are very scarce, and a prolonged search yielded only *Sphaerium corneum*, *S. lacustre*, *Pisidium obtusale* (1 example), *P. milium* (3 examples) and *P. pseudosphaerium* (2 examples). It seems clear that conditions suitable for *P. pseudosphaerium* can only have developed at Moira in recent years; certainly no-one would now expect to find there *P. amnicum* and *P. moitessierianum* as Stelfox did in 1919, and we may presume them extinct (I found a single long-dead valve of *P. amnicum*). Another striking change that has occurred is the appearance of *Planorbarius corneus*, a species unknown in this part of Ireland fifty years ago. It is now extremely abundant at Moira, hundreds of dead shells of large size forming a remarkable kind of shelly drift along the water's edge. Elsewhere in Ireland *P. corneus* has also invaded the Royal Canal, starting originally from Dublin before 1900, and since 1912 extending its range westwards from Moyvally by at least 45 miles, through Meath and Westmeath, as far as Keenagh, Longford (Kerney, 1968).

Such facts emphasize the instability of freshwater faunas. All the known habitats of *Pisidium pseudosphaerium* in Ireland—and possibly also in England—are artificial, and, therefore, far from being relics of a once wider range, as is often suggested for local species with discontinuous distributions, must represent fresh colonizations from elsewhere. The rather special conditions which *P. pseudosphaerium* seemingly requires can in any case only exist for a relatively short while during the progressive silting of a body of freshwater. It may well be that this rare species paradoxically possesses unusually effective means of passive dispersal to enable it to pass from one transient habitat to another.

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MARINE MOLLUSCA FROM THE CANARY ISLAND OF LANZAROTE

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INTRODUCTION

The marine flora and fauna of the Canary archipelago have received considerable attention from naturalists over the past century. The first of these studies was probably that of Webb and Berthelot (1836–54). These workers made an extensive study of Canary Island life—terrestrial and marine, and presented their findings in their famous book *Histoire naturelle des Iles Canaries.* D'Orbigny examined the molluscs collected by Webb and Berthelot and the results of his work form the first specialised study of the Canary mollusca. Since then several other naturalists have published papers on the molluscs of the Canary Islands, including Bergenhayn (1932), Dautzenberg (1890–91), MacAndrew (1852), Manzoni (1868) and Odhner (1932). After careful examination of these studies it became apparent that they were often the results of relatively short visits to the islands and that many of the records were, in fact, based on the collection of empty shells cast ashore. It was, therefore, considered desirable to make a careful study of the molluscan fauna of one of the islands. In 1965, in an attempt to achieve this aim, a team of biologists and divers from Edinburgh undertook a marine biological expedition to the island of Lanzarote in the eastern Canaries. The use of underwater diving techniques meant that the rocky areas out of the reach of both the shore collectors and ship-operated grabs and trawls would be studied for the first time, thus providing important ecological information about many of the sub-littoral species. This paper is the result of the molluscan survey carried out on that expedition.

The island of Lanzarote was selected as the survey area for the following reasons:

(i) It was the island that had probably received the least attention from large-scale survey.

(ii) It was near to the African coast (under 100 miles) and the findings of such an expedition would therefore be of interest to those workers interested in the West African flora and fauna.

(iii) Its sheltered eastern position (from Atlantic surf) and low-relief coastline made it an obvious starting point for the use of diving techniques, especially from a land-based expedition where access to the shore is a major consideration.

(iv) It was one of the islands that appeared to be least affected by modern development, including tourism.

METHODS

The expedition was an ecological study of an essentially qualitative nature although a limited amount of quantitative work was undertaken. The method adopted for specimen collection was intermediate between the "random" specimen collecting of the past and the more acceptable detailed transect and quadrat analyses of present-day ecology. Complete habitat samples were collected whilst on location for sorting, specimen identification and interpretation of ecological relationships on return to the laboratory. This necessitated the introduction of precise collecting and recording methods, providing information about:—

(i) location (see Fig. 1 for map showing survey localities),
(ii) depth (recorded in metres with mean low water level equivalent to 0 metres),
(iii) physical description of habitat (e.g. rock type, sand, mud, etc.),
(iv) community type (i.e. details of dominant species, e.g. *Cystoseira* belt),
(v) approximate measure of frequency of species,
(vi) other relevant ecological data.

Littoral species were collected at low tide. Sub-littoral species were collected by an underwater diving team using aqualung equipment. As stated above, every species observed in a particular habitat was collected. Only obvious (large) species were picked up individually. Other samples were collected *en masse*, ensuring the collection of all smaller species amongst the larger ones, e.g. a tuft of seaweed would be carefully transferred to a sample bag, ensuring that no small molluscs escaped. From the catalogue it can be seen that many species normally easily overlooked were recorded from rock scrapings or algal fronds, e.g. amongst *Cystoseira* or *Halopteris*. Whilst in the field, collectors kept all specimens in sea water, usually in polythene bags. In the case of specimens collected underwater, the larger specimens were placed in muslin bags whereas the "*en masse*" samples were placed in polythene bags. Information about underwater habitats, specimen behaviour, etc., was recorded on plastic drawing boards using grease pencils. The description of underwater habitats was also facilitated by the use of underwater photographic techniques. All data recorded by a diver underwater were transferred to data sheets immediately on coming ashore. If time or shore conditions prevented the completing of data sheets, the data was taped on a dictaphone for subsequent transfer to sheets.

The majority of specimen samples were preserved in neutral formalin (4 per cent formaldehyde in sea water) and stored in the presence of excess calcium carbonate. On return to Britain most molluscan species were washed during sorting from bulk samples and stored in 70 per cent. ethanol.

CATALOGUE

In the nomenclature synonyms have been omitted except on a few special occasions where discussion warranted their use.

If a species was recorded on more than one occasion it has been listed in Table 1 along with details regarding the number of localities where found and the number of samples containing the species. If there was only one record of the species it is listed in Table 2.

CLASS LORICATA

Order Chitonida

Family Cryptoplacidae

Acanthochitona crinitus (Pennant)

Several live specimens were at ARRIETA, at a depth of 3–5 metres. The expedition specimens are identical with those described by d'Orbigny as *Chiton fascicularis* L. Bergenhayn (1932) has cast doubt on d'Orbigny's identification and he suggested that his specimen is *Acanthochitona discrepans* (Brown) or *A. heterochaetus* Bergenhayn.

Family Ischnochitonidae

Ischnochiton cessaci de Rochebrune

Specimens were recorded from ARRIETA and ARRECIFE (south), on boulders from m.l.w.l. down to 15 metres. As far as is known this is the first record of this species from a Canary Island. It has, however, been recorded in West African waters.

Family Chitonidae

Chiton canariensis d'Orbigny

Live specimens were found at ARRIETA, attached to boulders (especially boulders dominated by the algae *Halopteris scoparia*) from m.l.w.l. to 10 metres. This species was recently recorded on Lanzarote by the Liverpool Expedition (1963) but was previously recorded as rare at Orotava (MacAndrew, 1852). It is also found on West African shores.

CLASS GASTROPODA

Sub-Class—Prosobranchia

Order Archaeogastropoda

Family Haliotidae

Haliotis tuberculata L.

This species was very common around the island. It was recorded from all survey localities, in fact 20 separate specimen samples included this species. It was found attached to boulders and rock outcrops in the sublittoral (0–20 metres), especially on coralline encrusted rock. Shells were found on most present-day beaches and also as semi-fossils on the raised beaches on the islet of GRACIOSA.

Family Fissurellidae

Diodora graeca (L.)

Juvenile and adult specimens were collected at PLAYA QUEMADA and ORSOLA, attached to rock, at a depth of 3–5 metres. This species was also recorded in the littoral zone, in rock pools at PLAYA QUEMADA, but it was never common.

Family Patellidae

Patella candei d'Orbigny

Empty shells of this species were found cast ashore at GRACIOSA and ARRIETA. Two semi-fossil shells were also found on the raised beach on GRACIOSA. Odhner (1932) equates *P. vulgata* L. and *P. candei* d'Orbigny. This may explain why the Liverpool Expedition (1963) reported *P. vulgata* L. as present on Lanzarote, but did not mention *P. candei* d'Orbigny.

Patella caerulea L.

Live specimens were found at a number of localities, including ARRIETA, ARRECIFE, PUNTA PECHIGUERA, EL GOLFO, and JAMEOS DEL AGUA. It was particularly common at EL GOLFO, attached to rock outcrops in the sub-littoral. The shells frequently provided support for a number of algal species, especially *Asparagopsis taxiformis, Dictyota* spp. and *Jania rubens*. From the examination of specimens in the Salisbury collection at the Royal Scottish Museum, Edinburgh, it appears that *P. caerulea* L. is synonymous with *P. crenata* Gmelin and *P. lowei* d'Orbigny. Odhner (1932), on the other hand, equates *P. aspera* Lamarck and *P. lowei* d'Orbigny but has *P. caerulea* Lamarck as a separate species.

Patella guttata d'Orbigny

This mollusc was not found alive at any location, but shells were found on sand at a depth of 5-8 metres in the RIO STRAIT. Other empty shells were found at this habitat, especially *Haliotis tuberculata*. *P. guttata* has been previously recorded from Lanzarote as recently as 1963 (Liverpool Expedition) but was recorded by MacAndrew (1852) as rare. Its exact status is therefore rather doubtful.

Family Trochidae

Cantharidus exasperatus Penn.

Many specimens of this mollusc were found on algae, e.g. *Caulerpa* spp. and *Halimeda tuna,* from ARRIETA, ARRECIFE (south) and JAMEOS DEL AGUA. They were found from m.l.w.l. down to 15 metres.

Cantharidus striatus (L.)

This trochid was recorded at ARRIETA, ARRECIFE (south), EL GOLFO and MONTANA CLARA. It was purely sub-littoral, being found amongst boulders or algae, e.g. *Cystoseira* sp. and *Codium* sp., from m.l.w.l. down to over 15 metres. At ARRECIFE it was found on sand in the beds of eel grass, *Zostera marina.*

Monodonta turbinata Born

Twenty different habitat collections included specimens of Monodonta. It was found in littoral and sub-littoral habitats at most localities around the island, including ARRIETA, ARRECIFE, PUNTA PECHIGUERA, RIO STRAIT and JAMEOS DEL AGUA. Its littoral distribution was usually restricted to crevices or rock pools, especially those of the lower shore. Although predominantly a littoral species it was found at depths of 0-70 metres, amongst algae or *Zostera* (at ARRECIFE, south). Frequently empty shells were found to be inhabited by hermit crabs, e.g. *Clibanarius misanthropus.* Live specimens were also found in the underground salt-water lake at JAMEOS DEL AGUA, where the water was several degrees colder than the outside sea and the light intensity was much lower.

Family Turbinidae

Astraea rugosa (L.)

Live specimens were found at ARRECIFE (wharf) on the underside of rocks at a depth of 30 metres; and at PLAYA QUEMADA, on sand at 5-10 metres. Shells were also collected on sand in the RIO STRAIT. At no location did this species appear to be common.

Tricolia pullus (L.)

This small (often minute) mollusc is almost certainly the commonest species in these waters. It was recorded at every locality visited and specimens were recorded from a total of 40 habitat samples. It is abundant in both littoral and sub-littoral regions, being recorded in collections down to 20 metres. In the littoral zone it was usually found amongst algae in rock pools. Similarly, in the sub-littoral region it was very common on fronds of algae, especially *Cystoseira* spp. and *Halopteris scoparia.*

Order Mesogastropoda

Family Littorinidae

Littorina striata King var. *affinis* d'Orbigny

This variety of *L. striata* was only collected at PUNTA PECHIGUERA, from the upper littoral zone, in crevices in the rock.

Littorina striata King

This species was recorded at ARRIETA, LA SANTA and JAMEOS DEL AGUA, although it probably existed elsewhere. It was restricted to the littoral zone, especially in crevices and pools in the mid and upper shore. This species is almost certainly that previously identified as *L. canariensis* (d'Orbigny), but it does not warrant classification as a separate species. It is however distinct from var. *affinis.*

Family Rissoidae

Alvania cancellata (da Costa)

One specimen of this species was recorded from boulder scrapings (5 metres) at ARRIETA. It is likely that this species is in fact fairly common but was simply overlooked.

Rissoa concinna Monterosato

Several specimens were found amongst algae collected at ARRIETA (0-5 metres), especially amongst *Halopteris* and *Stypopodium zonale.*

Rissoa costulata Alder

This species was frequently found amongst sub-littoral algae and rock scrapings (0-40 metres), from several localities, including ARRIETA, EL GOLFO, LA SANTA, MONTANA CLARA, and JAMEOS DEL AGUA. At ARRECIFE (south) it was found browsing over sponges at a depth of 20-30 metres. This species certainly appeared to be the commonest *Rissoa* of these coasts.

Rissoa picta Jeffreys

Several specimens were collected at ARRIETA, from boulder scrapings and amongst algal fronds, at depths of 0-5 metres.

Rissoa striata Adams var. *lyrata* Watson

One specimen was recorded from ARRIETA, from a sub-littoral algal sample (5 metres).

Rissoa violacea Desmarest

Several specimens were recorded amongst algae, collected from 3-10 metres at ARRIETA. They were common on fronds of *Halopteris scoparia,* but were also recorded on *Cystoseira* spp. and *Asparagopsis taxiformis.*

Family Turritellidae

Turritella triplicata (Brocchi)

Specimens were collected from open sand in the RIO STRAIT, at a depth of 8-20 metres. Shells were frequently recorded.

Family Cerithiidae

Bittium lacteum Philippi

Several specimens were recorded from the sub-littoral region (0-10 metres) at ARRIETA, usually amongst algal fronds, e.g. *Cystoseira* sp. and *Stypopodium zonale.*

Bittium reticulatum (da Costa)

This species was very common around the island (e.g. at ARRIETA, ARRECIFE, and JAMEOS DEL AGUA) amongst growths of sub-littoral algae, especially *Halopteris.* It was also recorded amongst stones on the sea bed, at depths ranging from 0-15 metres. Specimens were occasionally recorded from algae in littoral rock pools, e.g. at ARRIETA.

Cerithium rupestre Risso

At ARRECIFE (south) this mollusc was found in rock pools on the lower shore. Shells were also found in littoral pools, where they were inhabited by hermit crabs.

Cerithium vulgatum Bruguière

Specimens were found at most localities studied, including ARRIETA, ARRECIFE (south), PUNTA PECHIGUERA, LA SANTA and the RIO STRAIT. Live specimens were found in the sub-littoral, down to 20 metres, especially amongst algae on rocks. Shells were very common in the littoral zone, where they were inhabited by hermit crabs.

Family Cerithiopsidae

Cerithiopsis tubercularis (Montagu)

One specimen was collected at ORSOLA, on an algal encrusted boulder, beside a bed of white shell sand at a depth of 2 metres.

Family Triphoridae

Triphora perversa (L.)

One specimen (5mm long) was found at ORSOLA in a boulder scraping from the same habitat as described for the previous species.

Family Eulimidae

Eulima alba Donovan

Live specimens were found at ARRIETA, from an algal scraping at 4 metres (*Zonaria Stypopodium zonale* and *Jania rubens*). MacAndrew (1854) included a *Eulima* sp. in his list, as being found at Orotava, at a depth of 40-60 fathoms. This appears to be the first record of *Eulima alba* in the Canaries.

Family Naticidae

Natica marochiensis Gmelin var. *livida* Pfeiffer

Live specimens were recorded on sand in the *Zostera* beds at ARRECIFE (south) at a depth of 0-2 metres.

Family Cypraeidae

Cypraea spurca L.

Specimens of the race *atlantica* Monterosato (=*C. verdensium* Melvill) were common in the sub-littoral zone at ARRIETA and ARRECIFE (south), usually in debris or sand in depressions between boulders (3-10 metres). Empty shells were also common, often inhabited by hermit crabs. Similarly, shells washed up into littoral pools were often inhabited by hermit crabs.

Family Cymatiidae

Cymatium parthenopeum (Salis).

One live specimen (adult) was collected from a depth of 8 metres at ARRECIFE (south). It was found amongst boulders. This is a new record for the Canaries. The identification was confirmed by Mr. Waterston of the Royal Scottish Museum, Edinburgh.

Charonia nodifera (Lamarck)

Two live specimens were collected from the sub-littoral zone at ARRIETA. One was found amongst weed at 3 metres and the other on sand between boulders at 10 metres.

Family Tonnidae

Tonna galea (L.)

One empty shell (11 cm.) was found washed ashore at PLAYA QUEMADA.

Order Stenoglossa

Family Muricidae

Thais haemastoma (L.)

Live specimens were collected at ARRIETA, ARRECIFE, PUNTA PECHIGUERA and MONTANA CLARA, in all cases from the sub-littoral zone (3-20 metres), usually amongst boulders. At these and other localities, empty shells were very common, often inhabited by hermit crabs. Semi-fossil shells were also found to be very common in the raised beach deposits (e.g. GRACIOSA) and from Quaternary deposits. It seems likely, therefore, that this species has been particularly abundant in these waters for some considerable time. Records from the *Atlantide* Expedition (1945-6) indicate that the species is fairly common in West African waters.

Family Columbellidae

Pyrene canariensis (d'Orbigny)

One specimen was found amongst algae (*Halopteris, Jania* and *Caulerpa* spp.) at the edge of the sandy channel (2 metres) at ARRECIFE (south).

Columbella rustica (L.)

This species was very common in the sub-littoral zone at most localities, including ARRIETA, ARRECIFE, PUNTA PECHIGUERA, RIO STRAIT and JAMEOS DEL AGUA. It was recorded at depths of 0-30 metres, on rocks amongst algae (especially *Halopteris* and *Cystoseira*). Shells were often found washed ashore and were frequently inhabited by hermit crabs. Juvenile forms were particularly common on algal fronds such as *Halopteris scoparia*.

Family Nassariidae

Nassarius incrassatus (Ström).

A few live specimens and several shells were found amongst stones and sand at a depth of 0-5 metres off ARRECIFE (south).

Nassarius mutabilis (L.)

Live specimens were collected from under stones in the littoral zone, at ARRECIFE (south), and GRACIOSA (Caleta del Sebo). Empty shells were very common at a number of localities including ARRIETA and ARRECIFE, often inhabited by hermit crabs.

Nassarius pfeifferi Philippi var. *conspersa*

Live specimens were found under stones or amongst algae in littoral pools at ARRECIFE and LA SANTA.

Family Mitridae

Mitra fusca Swainson

One specimen was found under a stone in a rock pool on the lower shore at ARRIETA.

Mitra nigra d'Orbigny

Two specimens were recorded from rock scrapings in the sub-littoral (3-5 metres) at ARRIETA.

Mitra zebrina d'Orbigny

This species was found in both littoral and sub-littoral (0-8 metres) regions at ARRIETA and ARRECIFE. In the littoral zone it was restricted to rock pools, usually under stones. In the sub-littoral it was found on algae and from rock scrapings.

Family Marginellidae

Marginella glabella L.

Several species were recorded from ARRECIFE (south), mainly from under stones in the sub-littoral (0-10 metres), but occasionally under stones in rock pools on the lower shore.

Family Conidae

Cenus betulinus L.

Many live specimens were found at ARRECIFE (south) in sand at a depth of 30 metres. One empty shell was collected from sand (8 metres) at PUNTA PECHIGUERA.

Conus mediterraneus Hwass

This species was common at ARRIETA and ARRECIFE (south), especially in the sub-littoral (0-10 metres), where it was found in rock scrapings, crevices between boulders and amongst algae. Occasional specimens were found in rock pools on the lower shore. Many empty shells were inhabited by hermit crabs.

Conus papilionaceus Hwass

One large empty shell was found washed ashore at PLAYA QUEMADA.

Sub-Class Opisthobranchia

Order Pleurocoela

Family Hydatinidae

Hydatina stromfelti Odhner

Two live specimens of this mollusc were found partially submerged in sand in a *Zostera* bed (at 5-8 metres) in the RIO STRAIT. This is, as far as is known, the first record of living specimens of this endemic species. A full description is in preparation.

Family Aplysiidae

Aplysia dactylomela Rang

Several specimens of this large sea slug (over 30 cm. long) were found browsing over the *Zostera* bed (2 metres) off ARRECIFE (south).

Order Acoela

Family Dorididae

Doris punctata d'Orbigny

One specimen of this species (35 mm. long) was found on algal encrusted rock at a depth of 5 metres, off ARRIETA.

Family Polyceridae

Polycera webbi d'Orbigny

Two specimens (20 mm. long) were collected, one on rock at a depth of 25 metres off ARRECIFE (wharf) and the other on a boulder (8 metres) at ARRIETA. This identification is only tentative because specimens were preserved in 70% ethanol which made final confirmation virtually impossible.

CLASS LAMELLIBRANCHIA (BIVALVIA)

Order Taxodonta

Family Arcidae

Arcopsis lactea (L.)

This bivalve was very common in sand or amongst boulders in the sub-littoral zone (0-10 metres), e.g. at ARRIETA, ARRECIFE (south), RIO STRAIT and ORSOLA. Juvenile forms were found to be common amongst algae, (e.g. Cystoseira spp. *Dictyota dichotoma,* and *Stypopodium zonale* and from rock scrapings. Occasionally, specimens were found in rock pools on the lower shore. Several shells were found washed ashore.

Family Glycymeridae

Glycymeris glycymeris (L.)

Although this mollusc was probably quite common, only one live specimen was collected from sand at a depth of 25 metres off ARRECIFE (wharf). Several shells were recorded.

Order Anisomyaria

Family Mytilidae

Mytilus edulis L.

One valve was collected at ARRECIFE.

Family Pinnidae

Pinna rudis L.

This large fan-shell was relatively common in the sub-littoral zone (3-15 metres) at most localities, including ARRIETA, ARRECIFE, PLAYA QUEMADA, PUNTA PECHIGUERA, MONTANA CLARA, RIO STRAIT and JAMEOS DEL AGUA. It was attached to large boulders, but was never submerged in sand, gravel or silt unlike most *Pinna* spp.

In over 75% of the specimens examined, the commensal shrimp *Pontonia pinnophylox* (Otto) was found to be present. This crustacean has been recorded from other *Pinna* spp. throughout the Mediterranean, the Azores, and the West African coast, but this is probably a new record for the Canaries. In some cases two shrimps were present in each *Pinna* (one male and one female), but in others only one. The shrimp took up a position with at least part of its body enclosed in the folds of the mantle.

The nomenclature of this fan-shell has given the authors some difficulty but there seems little doubt that the species found was *P. rudis* L. This species was recorded (as valves) on Lanzarote by Webb and Berthelot (1836-54). A note by L. R. Cox in the British Museum collection suggested that some shells resembling these present Canary specimens were, in fact, *Atrina fragilis* (Pennant), but the shells bear little resemblance to most descriptions of *A. fragilis*.

Family Pectinidae

Chlamys pesfelis (L.)

Specimens of this species were recorded on sand in the sub-littoral zone (5-25 metres) at ARRIETA and ARRECIFE (wharf).

Spondylus gaederopus L.

Several live specimens of this species were found, e.g. at ARRIETA, MONTANA CLARA and JAMEOS DEL AGUA in the sub-littoral (8-25 metres), cemented onto cave roofs and rock overhangs. This strong attachment to solid rock explains why so few live specimens have been recorded.

As far as can be seen, all records from West African waters are based on empty valves. Many of the specimens observed were covered with algal growths, e.g. *Asparagopsis taxiformis.*

Family Linidae

Lima inflata Lamarck

Empty valves were found (semi-fossil) in a raised beach on GRACIOSA.

Lima squamosa (Lamarck)

Live specimens and valves were found in sand (0-30 metres), at several localities, including ARRIETA, ARRECIFE and the RIO STRAIT.

Order Eulamellibranchiata

Family Cardiidae

Acanthocardia echinata (L.)

Live specimens were obtained in sand at a depth of 8-15 metres, in the RIO STRAIT.

Acanthocardia tuberculata (L.)

Semi-fossil shells were collected from the raised beaches on GRACIOSA. They were most abundant in these deposits.

Family Veneridae

Venus verrucosa L.

Several live specimens were recorded in sand off ARRECIFE (wharf) at a depth of 20 metres, and in the RIO STRAIT (15 metres).

Venerupis aurea (Gmelin)

Two live specimens were found in sand at ARRECIFE (wharf), at a depth of 20-25 metres.

Dosinia lupinus (L.)

One live specimen was collected on the expedition, from a sub-littoral algal sample from ARRIETA (5 metres).

CLASS CEPHALOPODA

Sub-class Dibranchia

Order Decapoda

Family Sepiidae

Sepia officinalis L.

One small cuttlefish was observed at PLAYA QUEMADA, amongst *Zostera marina* at a depth of 8 metres.

Loligo forbesii Steenstrup

Two small squids were observed by divers, one in 15 metres off ARRECIFE (south), and another outside the harbour at Caleta del Sebo on GRACIOSA (5 metres). This species is frequently caught by the island fishermen who lure them to the surface at night by using bright lights suspended over the sides of their boats.

Order Octopoda

Family Octopodidae

Octopus vulgaris Lamarck

This species was very common indeed around the island shores, under ledges and boulders in the sub-littoral or just above m.l.w.l. Specimens were caught by divers at ARRIETA, ARRECIFE (south), PLAYA QUEMADA and in the

RIO STRAIT, but were observed at other localities. In the evening young specimens could be caught by luring them from cover (under ledges in pools around low tide mark) with a bright light, e.g. the local inhabitants used burning flares. A young specimen (3·5 cm.) was found inside a large cavity of a cup sponge, off ARRECIFE (30 metres).

DISCUSSION

The waters around the Canaries provide interesting conditions for marine biological study. Seasonal fluctuation in the temperature of the surface waters is minimal, although the actual temperatures are a little lower than expected for that latitude (Lanzarote—summer max.=23°C, winter min.=16°C). The sea temperature in the western half of the archipelago is about 3°C higher than in the eastern half. The presence of cooler water in the Lanzarote region is due to the effect of the upwelling of cold water to the NE of the archipelago.

Out of the 67 marine species recorded by the expedition, 60 species were represented by live specimens. This is an important feature of the results of employing underwater collection methods, because it should strengthen any interpretations of the present status of sub-littoral species in these waters. The exact status of the species represented only by shells is of some doubt. It is likely that live specimens of at least some of these species were overlooked.

Relatively few molluscs were found only in the littoral zone. These included,
on rock—*Littorina striata* and *L. striata* v. *affinis*,
in pools—*Nassarius pfeifferi*, *Cerithium rupestre* and *Mitra fusca*.
Several species were found to extend up from the sub-littoral to the littoral, e.g. *Patella caerulea* on rock, and in pools—

Arcopsis lactea
Bittium reticulatum
Cerithium vulgatum
Conus mediterraneus
Diodora graeca
Marginella glabella
Mitra zebrina
Monodonta turbinata
Nassarius mutabilis
Octopus vulgaris
Tricolia pullus

Of the large number of sub-littoral species recorded (42), some were found to live attached to rock and therefore live specimens would be unlikely to be found by shore collectors, e.g. *Pinna rudis, Spondylus gaederopus. Spondylus* would be particularly difficult to obtain because it lives cemented to the undersides of overhangs or cave roofs, and would be inaccessible even to grabs, trawls, etc. One of the most interesting species found was the exceedingly fragile Opisthobranch—*Hydatina strömfelti*, the endemic species first described from the shell by Odhner (1932), and now discovered living partially submerged in sand at a depth of 8 metres in the Rio Strait to the north of Lanzarote.

The methods used for sampling have also enabled many small species to be recorded amongst the fronds of algae, such as *Halopteris scoparia* and *Cystoseira* spp., the brown algae that dominate much of the sub-littoral region around the coasts of Lanzarote, (such molluscs include—*Rissoa* spp., *Bittium reticulatum, Tricolia pullus,* and *Cantharidus exasperatus.*

Although the expedition has managed to record a relatively large number of live specimens, there can be little doubt that sampling was insufficient, especially in certain areas. Three areas were examined fairly thoroughly—

Locality	*No. of Species*
Arrieta	37
Arrecife	38
Rio Strait	20

but other areas warrant further attention, especially the west coast of the island where work in 1965 was restricted by relatively rough seas.

At the start of the investigation it was hoped that some distinct relationship between algal and molluscan distribution might be found, but any relationships that exist must be fairly complex. For example, it may be that other smaller algae living as epiphytes on the larger brown algae provide the food required by the herbivorous molluscs. During the next expedition to Lanzarote (1967), the authors intend undertaking a study of the digestive capabilities of a number of the commoner molluscan species, in an attempt to establish any fine nutritional preferences of the various species.

From an examination of the list of mollusc species found around the coasts of Lanzarote it is obvious that the biogeographical relationships of the Canary Island fauna would provide an interesting subject for study, once more information has been made available from surveys of the other islands of the archipelago. The greater part (over 60%) of the Canary Island mollusca belong to the Lusitanian Element (Mediterranean, Spain, Portugal). Several species, that extend into northern waters, including the northern coasts of the British Isles, are approaching their southern limits in the Canaries, e.g. *Glycymeris glycymeris, Turritella triplicata,* and *Venus verrucosa.* Other members of this essentially Mediterranean fauna include—

Bittium reticulatum
Columbella rustica
Conus mediterraneus
Diodora graeca
Nassarius incrassatus
Spondylus gaederopus

Spondylus gaederopus is a rather interesting record because, according to Nicklès (1955), the common species in West African waters is *S. senegalensis* Schreibers.

The other two main components of the molluscan fauna are the essentially tropical species and the endemics. The most interesting of the warm water species is *Marginella glabella,* which is a West African species. It is very common on Lanzarote and Grand Canary, but has never been recorded west of Tenerife

(Fischer, 1946). Another tropical species is *Conus papilionaceus* but no live specimens were recorded from this expedition. The problem of endemism is rather interesting in the archipelago, but must be revised following the re-assessment of the status of certain species. Truly endemic species include *Pyrene canariensis* and *Hydatina strömfelti,* but *Chiton canariensis* has been found on the West African coast (Nicklès, 1950). The species *Littorina canariensis* is now believed to be synonymous with *L. striata*. Similarly, for this brief discussion the species of *Patella* are not being considered because their classification warrants further attention, there being considerable synonymy of species.

It is interesting to note that the dominance by the Lusitanian Element, with important secondary influence of Tropical and endemic species, also applies to many other groups of organisms, e.g. algae, crustaceans and fish.

GENERAL CONCLUSIONS

1. The use of aqualung diving techniques has given a more precise indication of the exact status and ecological distribution of many of the molluscs recorded in the archipelago. In this respect, many species previously recorded as shells have been found alive, and many species previously recorded as rare have been found to be relatively common.
2. Only a very broad relationship could be established between algal and molluscan distribution. Further work is required before any definite relationship can be established.

ACKNOWLEDGMENTS

We wish to express our thanks to His Royal Highness The Duke of Edinburgh and The Royal Geographical Society for providing grants towards the general running of the expedition. We wish to thank The Carnegie Trust for the Universities of Scotland, for giving a grant towards our personal expenses and for the purchase of specialist literature.

We are also very grateful indeed to the authorities of the British Museum (Natural History) for allowing Dr. Duffus access to the Museum collections, and to Mr. Norman Tebble and Mr. S. P. Dance for their valuable assistance with much of the nomenclature. Similarly, we wish to thank the Royal Scottish Museum for permitting us to inspect the A. E. Salisbury shell collection and to Mr. A. R. Waterston for his very kind assistance, particularly during the initial phase of specimen identification.

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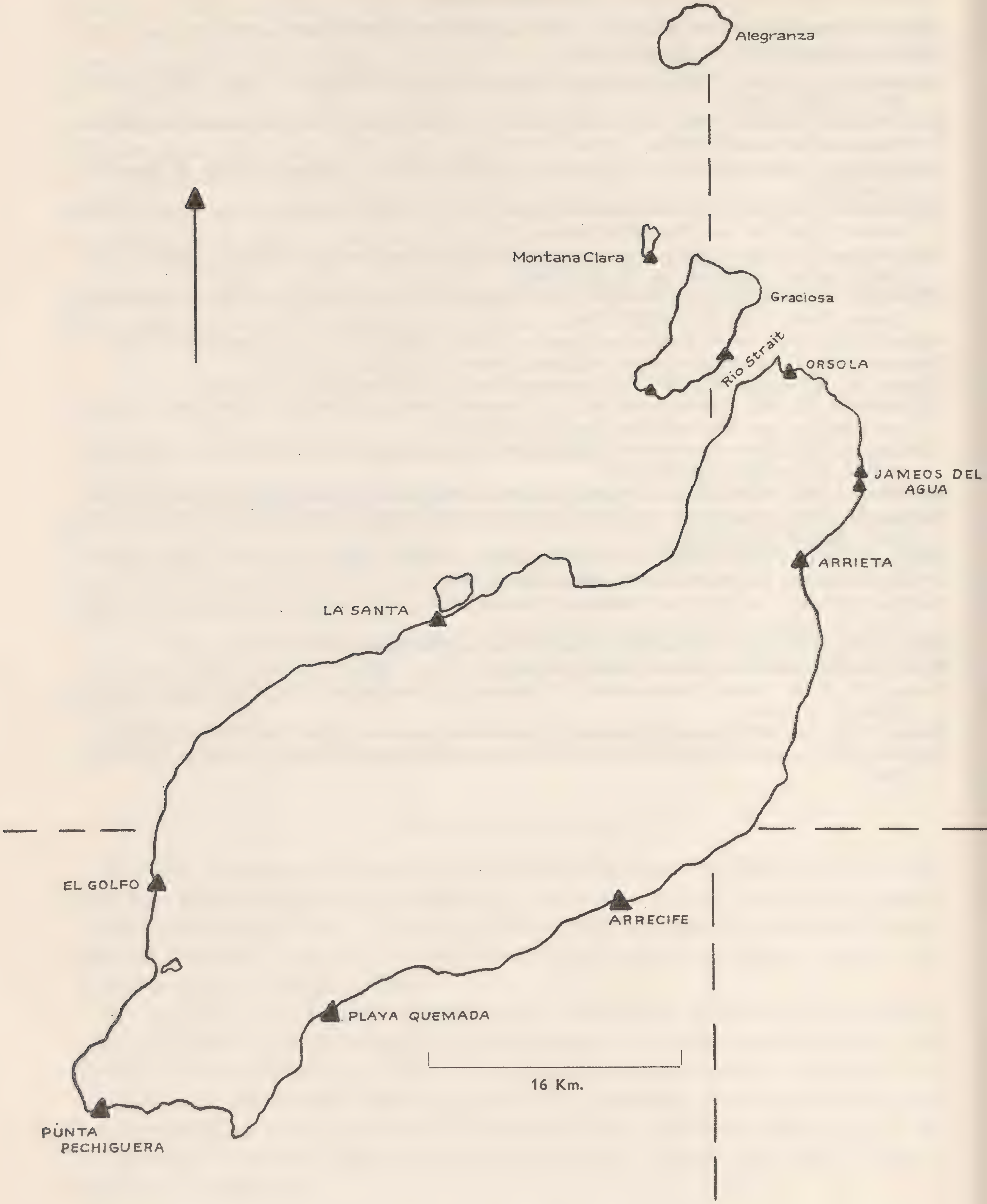

Fig. 1. *Island of Lanzarote*

TABLE 1

List of species of Molluscs recorded more than once on the expedition, giving number of localities where found (in order of freuqency), and number of samples containing species.

SPECIES		NUMBER OF LOCALITIES	NUMBER OF SAMPLES	SPECIES		NUMBER OF LOCALITIES	NUMBER OF SAMPLES
Tricolia pullus		11	40	*Conus betulinus*		2	5
Haliotis tuberculata		11	20	*Conus mediterraneus*	?	2	7
Pinna rudis		8	10	*Cypraea spurca*	?	2	5
Thais haemastoma		7	13	*Ischnochitona cessaci*		2	4
Columbella rustica		6	22	*Chlamys pesfelis*		2	3
Rissoa costulata	?	6	21	*Venus verrucosa*	?	2	3
Monodonta turbinata		6	20	*Cerithium rupestre*		2	2
Patella caerulea		6	7	*Diodora graeca*		2	2
Cerithium vulgatum	?	5	17	*Loligo forbesii*		2	2
Arcopsis lactea		4	16	*Nassarius pfeifferi*		2	2
Cantharidus exasperatus		4	12	*Polycera webbi*		2	2
Cantharidus striatus		4	8	*Chiton canariensis*		1	5
Lima squamosa		4	7	*Bittium lacteum*		1	4
Spondylus gaederopus	‡	4	5	*Marginella glabella*		1	4
Octopus vulgaris	?	4	4	*Acanthochitona crinitus*		1	2
Nassarius mutabilis		3	11	*Charonia nodifera*		1	2
Bittium reticulatum	?	3	10	*Mitra nigra*		1	2
Mitra zebrina		3	4	*Nassarius incrassatus*		1	2
S *Patella candei*		3	4	*Rissoa violacea*		1	2
Littorina striata	?	3	4				
Astraea rugosa		3	3				

? Denotes that it is likely that this species is commoner than this table suggests, because it was almost certainly overlooked in some of the localities.

‡ This species was recorded in other areas, therefore both figures are minimal; it was difficult to collect.

S This species was found only as empty shells.

TABLE 2

List of species of Molluscs recorded only from single samples

Acanthocardia echinata
S *A. tuberculata*
Aplysia dactylomela
Cerithiopsis tubercularis
S *Conus papilionaceus*
Cymatium parthenopeum
S *Tonna galea*
Doris punctata
Dosinia lupinus
Eulima alba
Glycymeris glycymeris
Hydatina stromfelti
S *Lima inflata*
Littorina striata v. *affinis*
Mitra fusca
S *Mytilus edulis*
Natica marochiensis v. *livida*
S *Patella guttata*
Pyrene canariensis
Alvania cancellata
Rissoa concinna
R. striata v. *lyrata*
Sepia officinalis
Triphora perversa
Turritella triplicata
Venerupis aurea

S This species was found only as empty shells.

J. Conch. 27: 46 (1969)

PSEUDAMNICOLA CONFUSA (FRAUENFELD) AT SHIREHAMPTON, GLOUCESTERSHIRE

D. G. Pickrell

2 Hardenhuish Lane, Chippenham, Wilts.

(*Read before the Society 16 November 1968*)

Whilst sorting through the W. W. Stoddart (1824–1880) collection of land and freshwater shells housed in the Bristol Museum two specimens labelled "*Hydrobia similis* Shirehampton" were discovered. These shells appeared on closer examination to be *Pseudamnicola confusa* (Frauenfeld) of which *Hydrobia similis* (Draparnaud) is a synonym. If these specimens are accurately localised this represents the first record for this species in the West Country (Ellis, 1951).

The rest of the material in this collection is well localised from Somerset and Gloucestershire and most of the determinations have been found to be correct and very few specimens came from outside the Bristol area.

Shirehampton is situated on the River Avon between Bristol and Avonmouth. The banks of the Avon have been investigated by the writer and could in the past have supported the above species, as they are slightly elevated above the normal tidal range of the Avon but subjected to periodic flooding with the formation of temporary pools of both brackish and fresh water. No mollusca have been found to date, obviously due to the general increased pollution of the river.

Acknowledgments are due to Bristol City Museum for access to their collections, to Dr. M. P. Kerney for confirmation of identification of specimens and to T. Pain for help and criticism.

REFERENCES

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J. Conch. 27: 47 (1969)

REVIEW

British Snails. A guide to the non-marine Gastropoda of Great Britain and Ireland. Pleistocene to Recent. By Arthur Erskine Ellis, with illustrations by R. A. Ellis. Oxford : Clarendon Press, 1969, pp. 298, 14 pls., price 45s.

The re-issue of this well-known book, out of print for twenty years, is a welcome event. For over forty years it has been the standard text-book in its subject, and the increasingly high prices fetched by the few copies appearing on the second-hand market testify to the continuing demand.

The present issue is basically a reprint by photolithography of the 1926 edition. The main text is reproduced in facsimile,, with pagination unchanged, though with minor corrections inserted where this could be done without disturbing the layout. The original photographic illustrations by R. A. Ellis are also reproduced. They appear a little harsher than in the first edition, but there has been no essential loss in clarity, and one or two figures appear actually to have gained in sharpness. One, however, misses the familiar picture of *Helix pomatia* embossed in gold on the cover, doubtless omitted for reasons of economy. Species added to the British list since 1926 are briefly described in an appendix, with references to relevant publications. There is also a special section of notes referring to points in the main text which require correction or amplification, and a new bibliography listing the more important recent books and papers dealing with European non-marine Mollusca. All this additional matter is presented in highly succinct and condensed form, but should allow the novice to trace the latest information on species of interest to him. For example, entries will be found on the several new species of slugs now recognised in Britain, such as *Arion lusitanicus* and the members of the *A. circumscriptus* complex, and information on fossil species has been brought up to date.

A valuable feature of *British Snails* is the citation under each species of primary sources and descriptions. This care over bibliographical sources is fully maintained in the new material.

British Snails is excellent value at 45s. Its re-appearance will undoubtedly give a stimulus to the study of British non-marine Mollusca and will introduce many people to a field from which they may have been deterred by lack of a suitable guide.

M. P. Kerney

J. Conch. *27*: 48 (1969)

REVIEW

A guide for the identification of the snail intermediate hosts of Schistosomiasis in the Americas, Washington: Pan American Health Organisation, 1968. Pp. ix, 132, 69 text-figs. Scientific Publication No. 168. Flexible card covers with plastic ring binding. U.S. $2.00.

Schistosomiasis in the Americas is caused only, so far as known, by *Schistosoma mansoni* and the authors of this book include the actual or potential intermediate hosts in the planorbid genus *Biomphalaria* (Preston, 1910). Some of the species considered to be valid have been classified in earlier literature as *Taphius*, *Tropicorbis* or *Australorbis*.

The book has been prepared by a group of 6 specialists as an introductory guide and contains a considerable amount of background information. It is pointed out in the Introduction that universal agreement has not been reached on some taxonomic questions. Brief accounts are given of the life cycle of *S. mansoni*, the ecology of its intermediate hosts, and the conchology and anatomy of freshwater snails with particular reference to *Biomphalaria*. A key to the families of freshwater snails occurring in the Neotropics is based on conchological features, while anatomical characters are utilised in a key to the species of *Biomphalaria*. The longest section summarises knowledge of 17 species of *Biomphalaria* under the headings shell, soft parts, geographical distribution, ecological features, genetics, epidemiological significance and nomenclature. Matters of nomenclature and taxonomy are not discussed in detail. Appendices deal with collection, preservation and laboratory rearing of snails, techniques for morphological study and experimental infection. The glossary is extensive and there is a classified bibliography. The book is lavishly illustrated with excellent line drawings.

A few inconsistencies and confusing statements were noticed. The terms "intermediate host" and "vector" are used as synonyms with nearly equal frequency. A range of temperature tolerance for *Biomphalaria* is given (page 1) with no indication of whether the limits are mean or extreme values. The meaning of the statement on page 1 "the water quality in certain habitats may be largely responsible for their [the snails] spotty distribution in otherwise suitable habitats" is not clear. The reference on page 5 to a figure of *Plesiophysa* as an example of an ovoviviparous snail is contradicted on page 13 by the remark that "all the freshwater pulmonates lay eggs and are therefore oviparous".

This book provides a valuable summary of knowledge that has hitherto been available only in numerous published papers. It owes a great deal to the detailed and excellently illustrated accounts of Neotropical Planorbidae published by Dr. W. L. Paraense and the late Mr. N. Deslandes and deserves to achieve its objective of stimulating and facilitating further research into the Neotropical *Biomphalaria*. Copies may be obtained apparently free from the Department of Scientific and Public Communications, Pan American Health Organisation, 525–23rd Street, N.W. Washington, D.C. 20037.

David S. Brown

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER, 1968

	£	s.	d.	£	s.	d.
Publications:						
News Letter				276	6	0
Student Papers				46	13	6
Journal:						
Vol. 26 No. 4	442	19	2			
Authors Reprints ...	25	2	6			
				468	1	8
Field Meetings				16	16	1
Bank Charges					10	0
Printing and Stationery & Postage ...				113	5	4
Officers' Expenses				47	6	6
Subscriptions				7	1	0
Donation to Linnean Society				10	10	0
				986	10	1
Net Surplus				1,013	19	6
				£2,000	9	7

	£	s.	d.	£	s.	d.
Fees and Subscriptions						
Membership Fees ...	767	19	9			
Subscriptions	272	18	2			
Entrance Fees	30	3	9			
				1,071	1	8
Donations				26	1	0
Sales:						
Old Journals (Final Payment) ...	589	0	0			
Advertising	4	5	0			
Journals	29	18	4			
Student Papers ...	33	5	10			
News Letter	11	3	3			
Authors Reprints ...	11	8	4			
Link Beschreibung ...	22	10	0			
Sundry Receipts ...	6	12	0			
				708	2	9
Investment Income:						
General Account ...	160	4	2			
Life Members Fund ...	35	0	0			
Reserve & Research Fund	50	9	9			
	245	13	11			
Transfer to Reserve & Research Fund	50	9	9			
				195	4	2
				£2,000	9	7

BALANCE SHEET AS AT 31 DECEMBER, 1968

	£	s.	d.		£	s.	d.	£	s.	d.
Fees and Subscriptions in Advance ...	106	12	5	Cash at Bank: Current A/C	517	6	6			
Life Membership Fund	710	0	0	Deposit A/C	1,351	5	7			
Reserve and Research Fund	1,100	0	0	Cash in Hand	3	0	9	1,871	12	10
Capital Stock	3,011	3	4							
Add Surplus	1,013	19	6	*Investments*						
				£400 5% Treasury Stock 1986/89 (£278 15 0) ...	344	0	0			
				£500 5¾% Deb. Stock Mersey Docks & Harbour Board 1976/78 (£398 15 0)	460	17	0			
				£572 13 5 6¾% Stock Greater London Council 1976 (£526 17 1) ...	574	0	3			
				2514 Units M. & G. Dividend Fund (£1,767 13 1) ...	1,522	1	2			
				£400 5⅝% Loan City of Norwich	400	0	0			
				£800 5½% Loan London County Council ...	769	4	0			
								4,070	2	5
	£5,941	15	3					£5,941	15	3

It will be noted that the previous investment of £650 in 6¾% Loan City of Birmingham does not appear. This was sold and the proceeds immediately re-invested in M. & G. Dividend Fund Units and in 6¾% Stock Greater London Council. As the transaction was carried out by the Trustees, the sale does not appear in the Treasurer's accounts.

Examined and found correct.

Charles Pettitt } Auditors.
Adrian Norris }

Marjorie Fogan
Hon. Treasurer
5 February 1969

J. Conch. *27*: 51–62 (1969)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

852ND (ORDINARY) MEETING, 18 JANUARY 1969

Communication. "Distribution of *Dreissena polymorpha* Pallas in Britain" by M. P. Kerney and B. S. Morton.
Subject for Discussion. British Freshwater Mollusca, introduced with a talk on Adaptation by Miss Chatfield.

Members Elected

Mrs. Eugenia M. Armstrong, 10 Severn Place, Efford, Plymouth, Devon.
P. Carpenter, 338 Acton Lane, London W.3.
Dr. Nicholas Edwards, Geology Department, The College of Technology, Burnaby Road, Portsmouth, PO1 3DJ.
H. C. Gay, Long Meadow, Ossemsley, New Milton, Hants.
Brian S. Morton, B.Sc., Department of Zoology, Chelsea College of Science and Technology, Hortensia Road, London S.W.10.
Miss Gillian Warland, Ardmore House, Lower Camden, Chislehurst, Kent.

Member Deceased

Professor H. L. Hawkins, F.R.S.

853RD (ANNUAL GENERAL) MEETING, 15 FEBRUARY 1969

In the Chair, the President, Dr. B. Verdcourt, and 51 members and friends present. Auditors : Mr. A. Norris and Mr. C. W. Pettitt were re-elected.

Report of the Council 1968–1969

Membership. It is with regret that the Society has to report the deaths of three of its members : D. K. Kevan, W. R. Dawson and Prof. H. L. Hawkins, F.R.S., who was a member of sixty-one years' standing. In addition 15 members resigned and 18 were deleted for non-payment of dues.

Newly elected members totalled sixty-five, including three previous Junior members, and one member was restored to the rolls. The result is a net gain of 31 compared with 27, 28 and 28 for the previous three years. Present membership is 432 which includes as before 17 life and 3 honorary members. Subscribers at 129 show a slight decline.

Meetings. One annual and seven ordinary meetings have been held at the British Museum (Natural History) by kind permission of the Trustees, the average attendance at 47 showing a steady increase. The attendance of 60 at the October meeting appears to be a record for the Society. Field meetings are the subject of a separate report.

Publications. An issue of the *Journal of Conchology* dated January 1968 was made in mid-April; this was in fact an issue in respect of 1967. Another issue marked October 1968 was made on 13 February 1969. Of the *Conchologists' Newletter* issues numbered 24 to 27 were made as usual in March, June, September and December. Members also received an Annual Membership listing and a syllabus of meetings. Two *Papers for Students* appeared.

Publicity. Unforeseen difficulties have delayed the presentation of the proposed film to the Council for its final approval. It must be remembered in this connection that the film is an amateur production costing the Society practically nothing, and we have therefore no cause for complaint about the delay. It is hoped, however, that members may be able to see the film before long.

Vote of Thanks. A vote of thanks was made from the Chair in respect of the Trustees for continuing use of their facilities.

Presidential Address. Dr. Verdcourt delivered his address, entitled "The Zoogeography of East African Molluscs".

Election of Officers and Council. The Officers and Council were declared elected, as shown on page 1.

TREASURER'S REPORT, 1968

I am pleased to present the accounts for 1968, as it will be seen that there is a rising trend apparent throughout the Society's sources of income. The figure for donations is the only one which is lower than in 1967, but as that year included Captain Diver's generous gift of £100 it would not be realistic to expect to reach the same total.

As mentioned in the 1967 Report, a scheme of payment of annual subscriptions by seven-year covenant was tried for the first time in 1968. Three of the officers of the Society signed covenants, and as a result of this the sum of £4 4s. 3d. accrued to the Society, and is included in the total of membership fees. So far, 25 covenants have been signed for 1969. No doubt there are other members who are eligible to join the scheme but who have not yet done so; I hope they will give consideration to this opportunity of benefiting the Society.

About twenty members are still in arrears with 1968 annual subscriptions. The annual subscription is due on 1 January. The rules of the Society state that members who are in arrears are not entitled to receive the Society's publications and that continuance in arrears will entail removal from membership: in view of the present cost of publications it is necessary for these rules to be enforced. I shall be very grateful if all members will try to pay promptly, and thus avoid unnecessary trouble and expense. Bankers' order forms are available for any who wish to use this method of payment. I must also remind all overseas members that all monies due to the Society are in £ Sterling. If foreign cheques are sent the members concerned must make allowance for conversion charges; these have been costing the Society four to five shillings on each subscription, and the aggregate loss is considerable.

During the year I was asked, as Treasurer, to investigate the position regarding Income Tax in connection with members engaged professionally in the study of the Mollusca, and as a result of this the Society has now been added to the list of those societies whose annual subscriptions may, in suitable circumstances, be subject to a rebate of Income Tax. Full information about conditions and procedure was published in the *Newsletter* for September 1968.

In 1968 the Society's investments were increased by the purchase of 1,075 M and G Dividend Units from the proceeds of the sale of back numbers of the *Journal of Conchology* to the Johnson Reprint Co. (second instalment). Later the £650 invested in City of Birmingham Bonds was realised, and the proceeds immediately reinvested in 825 M and G Dividend Units and £72 13s. 5d. Greater London Council 6¾%

Stock 1976. The latter transaction was carried out by the Trustees, and a note on the balance sheet explains that this did not actually enter into the Treasurer's accounts.

The additional holdings have led to an increase in the Society's income from investments, but it must be pointed out that this year's figures also include the amount received in return of Income Tax, which was not available for the previous year's report.

It will be seen that the Society has at present a very large balance in its deposit account. A portion of this consists of the third and final instalment of payment for *Journal* back numbers; this sum is to be invested and the matter is at present under consideration by the Council. The remainder consists almost entirely of the allocation for two parts of the *Journal* in 1968. Due to unfortunate delays these did not appear, but it is hoped to publish three parts in each of the years 1969 and 1970 in order to make up arrears.

There has been quite a marked increase in the sales of current publications. The *Papers for Students* have been in demand in educational circles, and several libraries have made enquiries with a view to obtaining both the *Papers* and the *Conchologists' Newsletter*. It has, therefore, been decided that in 1969 subscribers to the *Journal of Conchology* shall, as an experiment, be offered the opportunity of subscribing for these publications as an optional extra.

I hope that we shall be able to maintain the present encouraging trend, and that the Society can look forward to a satisfactory year in 1969.

MARJORIE FOGAN,
Hon. Treasurer

FIELD MEETINGS

Seven field meetings were held during 1968 as follows: 23 March, Stonehouse, Gloucestershire. 27 April, Leicester area. 19 May, Battle, Sussex. 20 July, West Mersea, Essex. 4 August, Faversham, Kent. 22 September, Roade and Blisworth, Northants. 20 October, Newbury, Berkshire. One was cancelled, due to the June rail dispute. In addition the following meetings were organised by the North-West Mollusca group: 24 February, Ainsdale, South Lancashire. 23 March, West Kirby, Cheshire. 6 April, Speke, Lancashire. 11 April, Lytham, Lancashire. 25 May, Pilling, Lancashire. 16 June, Nether Kellett, Lancashire. 20 July, Shropshire Union Canal near Beeston, Cheshire. 21 September, Altmouth, South Lancashire. 5 October, Huyton, South Lancashire. 24 November, Knowsley Park, South Lancashire.

Thanks are due to the following for leading these meetings: Mrs. N. F. McMillan, Mrs. M. Fogan, Mrs. P. List, Mrs. J. Llewellyn-Jones, Miss J. E. Chatfield, Messrs. D. Harfield, N. F. Ellison, A. A. Bain, B. Dennison, E. Greenwood, G. Whitfield, D. C. Long, I. M. Evans, A. P. H. Oliver, E. Philp, G. Osborn, R. H. Martin.

Details of many of these meetings are published in the *Conchologists' Newsletter*. Field metings are also held by the Society's Yorkshire Branch.

A feature of our field meetings over the last two years has been annual joint meetings with the Northampton Natural History Society and the Kent Field Club. It is hoped to extend these to include other interested societies in future programmes.

T. PAIN

RECORDER'S REPORT: NON-MARINE MOLLUSCA

A. 10-KILOMETRE SQUARE MAPPING

Some 13,000 new records were incorporated in 1968. The third progress map was issued in *Newsletter* No. 28, March 1969. In lowland England progress continues to be satisfactory, but Wales, Scotland and Ireland have been relatively neglected and once again I appeal to members for special efforts in those areas.

On the recommendation of the Biological Records Centre, it has been decided to use in future the Irish National Grid, not the British Grid extension (Biological Grid) as hitherto. Most other societies concerned with distribution mapping have agreed to this proposal, which obviates the need for specially gridded maps and which it is hoped will encourage recording in Ireland.

B. Vice-county Records

The following have been verified since the last Recorder's report (*J. Conch.* **26**: 344). A 1-kilometre square grid reference (if available) is appended to each record. Unless otherwise stated, the date of collection was 1968. The large number of new Irish records reflects the success of a Conchological Society excursion to Ireland in April 1968 (*Ir. Nat. J.* **16**: 85–89.

Cornwall West (1): *Acicula fusca,* Fox's Lane, Falmouth (10/8132), 1912 (City of Liverpool Public Museums).

Wilts North (7): *Agriolimax caruanae,* Swindon (garden; 41/1482), I. K. Dawson; *Pisidium milium, Pisidium pulchellum,* River Kennet, Chilton Foliat (41/2971), M. P. Kerney, 1969.

Wilts South (8): *Potamopyrgus jenkinsi,* River Avon, Fifield (41/1450); *Vitrina major,* Stert Valley, Devizes (41/0259), both I. D. Finney.

Hants South (11): *Acicula fusca,* Buriton (41/7419), R. A. D. Cameron.

Hants North (12): *Acicula fusca,* Beech (41/6838); *Vertigo antivertigo, V. moulinsiana,* Avington (41/5232), all M. P. Kerney; *Pisidium supinum,* River Wey, Bentley (41/8044), M. P. Kerney, 1967.

Sussex East (14): *Anodonta complanata,* River Ouse, Barcombe (51/4314), B. Colville.

Kent East (15): *Columella edentula,* Benenden (51/8333); *Arion lusitanicus,* Ramsgate (garden; 61/3665); *Milax gagates,* Aylesford (51/7358), all E. G. Philp.

Kent West (16): *Monacha granulata,* Leybourne (51/6959), E. G. Philp; *Arion lusitanicus,* West Wickham (51/3866), Miss S. M. Davies.

Surrey (17): *Abida secale,* Coulsdon (51/35), 1910 (City of Liverpool Public Museums).

Essex North (19): *Succinea elegans,* Royden (52/4110), L. Lloyd-Evans; *Pisidium moitessierianum,* River Blackwater, Witham (52/8415), R. Fresco-Corbu.

Berks (22): *Abida secale,* Uffington (41/3086), Miss June Chatfield.

Oxford (23): *Milax budapestensis,* Woodstock (42/4417), R. C. Higgins; *Pisidium hibernicum, P. pulchellum,* River Ray, Blackthorn (42/6219), M. P. Kerney.

Suffolk East (25): *Segmentina nitida,* Barnby (62/4790) (confirmation of old untraced vice-county record); *Succinea elegans,* Share Marsh, Oulton Broad (62/5091); *Milax sowerbyi,* Carlton Colville (garden; 62/5190), all D. C. Long.

Norfolk East (27): *Pisidium moitessierianum,* River Yare, Whitlingham (63/2807), M. Goodchild, 1963.

Norfolk West (28): *Vertigo moulinsiana,* West Acre (53/7815), L. Lloyd-Evans; *Pisidium henslowanum,* River Wissey, Stoke Ferry (52/7099), M. P. Kerney; *Dreissena polymorpha,* River Wissey, Hilgay (52/6298), Great Ouse River Authority, 1964 (per B. S. Morton).

Bedford (30) : *Vitrina major,* King's Wood, Heath and Reach (42/9229), L. Lloyd-Evans; *Pisidium tenuilineatum* (dead valve), River Ouse, Bromham (52/0150), M. P. Kerney.

Huntingdon (31) : *Potamopyrgus jenkinsi,* Ramsey St. Marys (52/2587); *Vallonia excentrica,* Little Paxton (52/1862), both L. Lloyd-Evans; *Anodonta anatina,* Stibbington (52/0899), P. Cambridge.

Northampton (32) : *Zonitoides excavatus,* Dallington Heath, Harlestone (42/7263); *Milax sowerbyi,* Whitehills, Northampton (garden; 42/7464), both Mrs. P. List; *Milax budapestensis,* Lilford Hall, Pilton (52/0284), L. Lloyd-Evans.

Gloucester East (33) : *Vertigo substriata,* Cranham Wood (32/9013); *Hygromia subrufescens,* Dovedale, Blockley (42/1633), both D. C. Long.

Gloucester West (34) : *Vitrina major,* Newland (32/5408), D. C. Long.

Monmouth (35) : *Sphaerium lacustre,* Rumney (31/2278), S. P. Dance.

Hereford (36) : *Oxychilus helveticus,* Ledbury (32/7238), D. G. Pickrell, 1967.

Worcester (37) : *Balea perversa,* Overbury Park, Bredon Hill (32/9639), D. C. Long; *Oxychilus draparnaudi, Agriolimax caruanae,* Worcester (32/8454), M. W. Rowe.

Warwick (38) : *Pupilla muscorum,* Southam (42/4062), M. W. Rowe.

Glamorgan (41) : *Vertigo pusilla,* Merthyr Mawr (21/8776), S. P. Dance, 1969.

Brecon (42) : *Columella edentula,* Corn Du (22/9722); *Vallonia excentrica,* Pontsticill (32/0511), both S. P. Dance; *Vertigo substriata,* Nant Cwm Du (22/9421), D. C. Long.

Radnor (43) : *Potamopyrgus jenkinsi,* Boughrood (32/1240); *Hygromia subrufescens,* Llanstephan (32/1241), both S. P. Dance.

Carmarthen (44) : *Columella edentula,* Cwmgwili (22/5709); *Vertigo pygmaea,* Brandy Hill (22/2113), both S. P. Dance.

Flint (51) : *Oxychilus draparnaudi,* Mold (33/2363), Mrs. M. Fogan.

Lincoln South (53) : *Anodonta anatina,* River Welland, Spalding (53/2318), J. Gooding.

Leicester (55) : *Marpessa laminata, Retinella pura, Limax cinereoniger, L. marginatus,* Loddington Reddish Wood (43/7702), Mrs. L. Lloyd-Evans and G. Pitchford; *Milax budapestensis,* Loddington (43/7702), Mrs. M. Fogan; *Oxychilus draparnaudi,* Oakham (43/8509), L. Lloyd-Evans; *Agriolimax caruanae,* Mount St. Bernard's Abbey, Charnwood Forest (43/4515); *Pisidium hibernicum,* Grand Union Canal, Foxton (42/6888), both M. P. Kerney.

Derby (57) : *Milax sowerbyi,* Matlock Bath (43/2958), Miss June Chatfield; *Pisidium henslowanum,* Bretby (43/2923), R. C. Preece.

Lancaster West (60) : *Milax sowerbyi,* Lytham (34/3627), B. Dennison; *Limax marginatus,* Fulwood (34/5339), Mrs. M. Fogan.

York South-east (61) : *Acanthinula aculeata,* Cherry Burton (54/0041); *Cecilioides acicula,* Ruston Parva (54/0762), 1964; *Oxychilus helveticus,* Broomfleet (44/8725); *Unio pictorum,* River Derwent, Stamford Bridge (44/7155); *Dreissena polymorpha,* Newport (44/8530), 1965, all A. Norris.

York North-east (62) : *Vallonia excentrica,* Pickering (44/7984), R. C. Preece.

York North-west (65) : *Segmentina complanata, Sphaerium lacustre,* Hornby Castle (44/2293), Miss Gunningham; *Vertigo substriata,* Cronkley Fell (35/8628), Mrs. J. A. Paton.

Isle of Man (71) : *Agriolimax caruanae,* Dhoon Glen (24/4586), Dr. Larch Garrad.

Aberdeen North (93) : *Arion subfuscus,* Drumdelgie (38/4842), E. Kellock, 1967.

Easterness (96) : *Helix nemoralis,* Foyers (28/4920), J. S. Jones, 1966.

North Ebudes (104) : *Potamopyrgus jenkinsi, Margaritifera margaritifera,* Stensholl River, Staffin, Skye (18/4867); *Planorbis contortus,* Loch Fada, Skye (18/4948); *Vertigo pygmaea,* Bearreraigh Bay, Skye (18/5152); *Hygromia striolata,* Portree, Skye (18/4743), all R. C. Preece.

Ross West (105) : *Oxychilus helveticus, Milax budapestensis,* Courthill, Kishorn (18/8341), E. Kellock.

Kerry North (H 2) : *Vitrina pyrenaica,* Torc Cascade, Killarney (V 9684), Mrs. M. Fogan.

Cork Mid (H 4) : *Vallonia costata,* Blarney Castle (W 6175); *V. excentrica,* Charles Fort (W 6549), both Mrs. M. Fogan.

Cork East (H 5) : *Pisidium pulchellum,* Mallow (W 5698), Mrs. M. Fogan.

Waterford (H 6) : *Agriolimax caruanae,* Lemybrien (S 3211), M. P. Kerney.

Tipperary South (H 7) : *Vallonia excentrica,* Rock of Cashel (S 0740), Mrs. M. Fogan.

Kilkenny (H 11) : *Vallonia excentrica,* Jerpoint Abbey (S 5740), Mrs. J. A. Paton.

Kildare (H 19) : *Planorbis vortex, Pisidium personatum, P. pseudosphaerium,* Royal Canal, Moyvally (N 7242); *Acroloxus lacustris, Pisidium pseudosphaerium,* Royal Canal, Leixlip (N 9936); *Milax budapestensis, Agriolimax caruanae,* Maynooth (N 9637), all M. P. Kerney; *Succinea oblonga,* Knockanally House (N 8037), D. C. Long.

Wicklow (H 20) : *Milax budapestensis,* north of Roundwood (O 10), R. O'Connor; *Agriolimax caruanae,* Kerrybank, Arklow (T 2573), M. P. Kerney.

Dublin (H 21) : *Arion lusitanicus,* Bushy Park, Dublin (O 1529), A. Norris; *Agriolimax caruanae,* Monkstown Park College, Dublin (O 2328), R. O'Connor, 1967.

Meath (H 22) : *Planorbis vortex,* Royal Canal, Ferns Lock (O 8527), Miss June Chatfield and A. Norris; *Milax budapestensis, Agriolimax caruanae, Pisidium henslowanum, P. hibernicum,* River Boyne, Beauparc Bridge (N 9171) M. P. Kerney and A. Norris.

Westmeath (H 23) : *Potamopyrgus jenkinsi, Agriolimax caruanae, Pisidium obtusale,* Mullingar (N 4453), Miss June Chatfield; *Bithynia leachi, Planorbarius corneus, Oxychilus draparnaudi,* in and by Royal Canal, Mullingar (N 4352); *Columella edentula, Pisidium pseudosphaerium,* in and by Royal Canal, Footy's Hill, Killucan (N 5549), all M. P. Kerney; *Vallonia costata, V. pulchella,* D'Arcys Bridge, Killucan (N 5949), Mrs. M. Fogan and A. Norris; *Vertigo substriata, Pupilla muscorum,* Ballynacarrigy (N 3059), A. Norris.

Longford (H 24) : *Acicula fusca, Bythinia leachi, Lauria anglica, Acanthinula aculeata, Vallonia costata, V. excentrica, Balea perversa, Oxychilus alliarius, Pisidium hibernicum,* in and by Royal Canal, Lyneen Bridge, Killashee (N 0967), M. P. Kerney and D. C. Long; *Vertigo antivertigo, V. pygmaea, V. moulinsiana,* by Royal Canal, Island Bridge, Keenagh (N 1163), Miss June Chatfield and A. Norris; *Potamopyrgus jenkinsi, Aplexa hypnorum, Planorbis leucostoma, Pisidium obtusale, P. henslowanum,* Cloonart Bridge, Newton Forbes (N 0883), M. P. Kerney; *Planorbarius corneus, Columella edentula, Vertigo substriata, Punctum pygmaeum,* in and by Royal Canal, Abbeyshrule (N 2159), M. P. Kerney and D. C. Long; *Arion intermedius,* Abbeyshrule (N 2259), M. P. Kerney.

Sligo (H 28) : *Milax budapestensis*, by Glencar Lough (G 7343), A. Norris.

Leitrim (H 29) : *Potamopyrgus jenkinsi, Vallonia pulchella, V. excentrica, Sphaerium lacustre, Pisidium hibernicum, P. pulchellum,* in and by Bran Lough, Carrick-on-Shannon (G 9602), M. P. Kerney; *Succinea oblonga,* Roosky, by Lough Melvin (G 8952), Miss June Chatfield; *Agriolimax caruanae,* Drumshanbo (G 9611), Mrs. M. Fogan.

Cavan (H 30) : *Potamopyrgus jenkinsi, Pisidium lilljeborgi, Milax budapestensis,* in and by Lough Macnean Upper, Gortahill (H 0337), M. P. Kerney.

Louth (H 31) : *Milax budapestensis,* Temple Demesne, Collon (N 9983; associated with *Vitrina pyrenaica*), M. P. Kerney.

Fermanagh (H 33) : *Acicula fusca,* Wheathill Woods (H 1235), D. C. Long; *Aplexa hypnorum,* by Lough Macnean Lower, Marlbank (H 0937); *Vallonia pulchella,* Glebe House, Enniskillen (H 2348), both M. P. Kerney; *Ena obscura,* near Hills Island, Lower Lough Erne (H 0558), Mrs. M. Fogan; *Arion lusitanicus,* Royal School, Enniskillen (H 2244); *Pisidium personatum,* Florencecourt (H 1735), both Miss June Chatfield; *Pisidium conventus,* Lough Aguse, Kiltyclogher (G 9948), A. W. Stelfox, 1909 (British Museum collection; this specimen, figured by B. B. Woodward as "*Pisidium lilljeborgii*" (*Catalogue of the British species of Pisidium.* London : British Museum (Natural History), 1913, plate 28, figures 25a and b), was re-examined recently by J. G. J. Kuiper and S. P. Dance and determined as a well-developed mature example of the present species).

Donegal East (H 34) : *Vertigo antivertigo, Milax budapestensis,* Bundoran (G 8360), Mrs. M. Fogan and A. Norris.

Armagh (H 37) : *Planorbarius corneus, Milax budapestensis, Pisidium personatum,* Caledon (H 7644), M. P. Kerney; *Agriolimax caruanae,* by Lowry's Lough, Armagh (H 9144), Miss June Chatfield.

Antrim (H 39) : *Pisidium pseudosphaerium,* Lagan Canal by Moira station (J 1561), M. P. Kerney.

The following segregates of *Carychium*, *Cochlicopa* and *Vitrea* have also been verified :

Carychium minimum : 10, 26, 31, 37, 39, 42, 43, 44, 57, 66, H 2, H 4, H 5, H 6, H 20, H 21, H 22, H 23, H 24, H 28, H 29, H 30, H 33, H 34, H 37, H 39.

Carychium tridentatum : 11, 31, 42, 43, 68, H 5, H 7, H 21, H 22, H 23, H 24, H 27, H 29, H 31, H 33, H 37, H 39.

Cochlicopa lubrica : This species is probably ubiquitous; no further records will be published.

Cochlicopa lubricella : 6, 32, 34, 53, 55, 57, 91, H 5, H 7, H 15, H 19, H 22, H 23, H 24, H 28, H 29, H 33, H 34, H 37.

Vitrea crystallina : 10, 30, 34, 35, 43, 54, 90, 104, H 1, H 5, H 6, H 7, H 8, H 11, H 19, H 22, H 23, H 24, H 28, H 31, H 33, H 37, H 39.

Vitrea contracta : 10, 11, 21, 28, 29, 32, 34, 51, 66, 78, 90, 91, H 5, H 6, H 8, H 11, H 12, H 15, H 19, H 20, H 21, H 22, H 24, H 28, H 30, H 31, H 33, H 34, H 37, H 39.

A start has been made in accumulating records of the recently segregated species

Arion fasciatus, sensu Walden (the yellowish or reddish form of *Arion circumscriptus* (agg.)).

Arion fasciatus (seg.) : 15, 17, 38, 39, 51, 55, 65, 112, H 31.

The following records are to be deleted from the Census :

Sussex West (13) : *Sphaerium transversum.* The specimens on which this record is based, collected in 1953 from the Chichester Canal at Hunston (41/8501 : *J. Conch.* **23** : 417), are very large, quadrate examples of *Sphaerium lacustre.*

Suffolk West (26) : *Dreissena polymorpha.* No substantiation for this record can be traced.

York North-east (62) : *Dreissena polymorpha.* The record is based on a specimen in the Bean collection (early nineteenth century) in the Scarborough Museum, supposedly from York. Mr. A. Norris, who has recently re-examined the Bean collection, tells me that the old hand-written label to this specimen reads "Yorks", not York.

The most interesting records of the past year are all from Ireland. First, there is the discovery of *Pisidium pseudosphaerium* in Kildare, Westmeath and Antrim, new to the Irish fauna. A third Irish locality is now known for the arctic species *Pisidium conventus.* Mrs. Fogan has verified the suspected occurrence of *Vitrina (Semilimax) pyrenaica* at Torc Cascade near Killarney (*Ir. Nat. J.* **16** : 175), making it likely that this lusitanian snail may indeed be indigenous, and not an introduction as hitherto believed. *Arion lusitanicus* has been detected at two further localities in Ireland, in Dublin and Fermanagh. *Succinea oblonga* has been verified from Kildare and Leitrim, and *Vertigo moulinsiana* from Longford. Specimens of *Planorbarius corneus* have been seen from Westmeath, Longford and Amagh, and reports of this species—unconfirmed but almost certainly correct—have been received from Cork West and East, Galway North-east, Roscommon, Leitrim, Cavan, Monaghan and Tyrone. Fifty years ago *P. corneus* was seemingly very local in Ireland, but it appears to have spread greatly in recent years (a similar extension of range, no doubt through human agency, is apparent in England and Wales).

Among the new British records, perhaps the most interesting is Mr. Kellock's find of *Oxychilus helveticus* in Ross-shire, the most northerly known European station. *Milax budapestensis* was found in association, and the colony may be introduced. Three further localities for the very local *Vitrina major* have been discovered in the south of England. Other records of rarities are *Succinea elegans* in Essex North and Suffolk East, *Vertigo pusilla* in Glamorgan, *Vertigo substriata* in Gloucester East, *Vertigo moulinsiana* in Hants North and Norfolk West, *Arion lusitanicus* in Kent East and West, *Limax cinereoniger* in Leicester, *Pisidium moitessierianum* in Essex North and Norfolk East, and *Pisidium tenuilineatum* in Bedford.

M. P. Kerney

RECORDER'S REPORT : MARINE MOLLUSCA

If progress can be reckoned by the growth of authenticated species records in the fattening files and the increasing ease with which the state of recording in any one Area can be checked, the Census is indeed progressing. Since the last A.G.M. over 300 communications have been received and answered and some 30 batches of specimens checked or identified. Many dozen completed recording forms have been submitted and filed, with notes against those species that have been confirmed as new records for the Areas concerned. More time has also been spent on extracting records from various published work. As last year, notes are appended on some of the aspects of the Census work.

PUBLICITY. Mrs. N. F. McMillan, past Marine Recorder and member of the Marine Census Subcommittee includes a special mention of the Census on page 2 of her awaited book *British Shells,* published at the end of 1968. The present Marine Recorder has focussed further attention on the Census in a practical day by having the definitions of the Marine Areas together with the map, prototype recording form and some basic notes on collecting, published as *Papers for Students* No. 11 "Collecting British marine molluscs". The British Sub-Aqua Club's A.G.M. was held at Torbay during Easter 1968 and at the request of Mr. K. H. Moncad of the Torbay Club a collection of literature, books and maps detailing the Census work, with lists of species found in C.A. 16, Portland, was sent for display: this attracted much attention and gained at least one new member for the Society.

GROUP SHORE WORK. The results of group work in C.A. 13, Thames, duly appeared in the *Conchologists' Newsletter* No. 25, providing a firm basis for further research. A dredging expedition in the Blackwater Estuary (C.A. 13) was successfully organised by Dr. J. Llewellyn Jones in August. The only other group meetings for 1968 were in C.A. 24, Liverpool Bay, for which a comprehensive list, comprising records for last century as well as the present, is being compiled, Mr. L. D. Harfield acting as secretary and Mrs. McMillan checking the records. The resultant list will appear in the *Conchologists' Newsletter* in the near future.

SOME INDIVIDUAL SHORE WORK. Many people have sent in the results of their observations in various Areas, but the following warrant special attention. Dr. Shelagh M. Smith has worked hard to promote C.A. 7, Firth of Forth, for which there are now 160 present-century records. She has submitted 14 completed forms, many of the species being new to the list compiled for the Area by Dr. D. K. Kevan between 1929 and 1933 when Mr. A. Gardiner was the Recorder. Some of Dr. Smith's new Area records have been checked by Mr. D. Heppell at the Royal Scottish Museum whilst others have been sent direct to the Recorder. Lists of subfossil species for Firth of Forth have also been received from her as well as some detailed Beach Directory information and batches of voucher specimens from this Area and Area 30, Minch. In C.A. 3, Orkney, junior member Alistair Skene, assisted by his father, Mr. Alan Skene, is continuing the studies of Rendall on the marine molluscs of Orkney and he has even discovered several species new to the latter's list (see Rendall, R., 1956. Mollusca Orcadensia. *Proc. Roy. Soc. Edin.*, B, **66**, pt. 2, No. 7, and the *Conchologists' Newsletter* No. 26). Altogether 28 completed forms have been received from the Skene family, containing detailed recent reports of many of the species briefly listed by Rendall. Mrs. McMillan has acted as referee for the Orkney material. A new member, Mrs. E. S. Rands, has sent in forms from various Areas and these have included a number of new records; her family have helped with the form-filling as well as the collecting whilst Mr. L. W. Stratton has checked all the species of which Mrs. Rands has submitted records. Mrs. J. C. Charlish and Mrs. A. M. Brockbank have continued to send lists and specimens from many Areas and have in particular contributed extensively to C.A. 22 and some Irish Areas.

A SELECTED RECORD AND ITS SIGNIFICANCE. Acanthochitona communis (Risso) (=*A. discrepans* in Jeffreys 1865 **3**: 214 and in Forbes and Hanley 1853 **2**: 396. Non *discrepans* Brown) has rarely been found north of the Channel Isles, and all records to date have suggested that in Britain it is restricted to the South-West. In August 1968 a single example was found by Dr. Shelagh Smith at Loch Toscaig, South Applecross, Wester Ross (Census Area 30, Minch) in shallow water at low spring tide. Dr. Gillian Matthews has kindly confirmed the identification and the specimen has been housed in the collections of the Royal Scottish Museum, Edinburgh. Many southern species of animals and plants occur sparingly along much of the west coast of Britain, especially where the Gulf Stream influence on the Welsh and Scottish coasts has its complex effects: this find of *A. communis* indicates that the species should occur at other stations on the west coast of Scotland and that some search might be made in the areas that lie between Census Area 23, Anglesey (in which there is a single record for Holyhead) and C.A. 30. However, it would seem more likely that *A. communis* will be found off the southern and western coasts of Ireland where the North Atlantic drift again approaches land. Other records so far compiled in the Census lists are for C.A. 14, East Channel (Beachy Head, Sussex); C.A. 15, Wight (Bembridge, Isle of Wight, and Brighton, Sussex); C.A. 16, Portland (Chideock, Dorset); C.A. 17, Channel Isles (Jersey, Guernsey and Herm); C.A. 18, West Channel (Plymouth, Devon, and Helford, Cornwall); C.A. 21, Bristol Channel (Milford Haven). What scanty ecological data there is to hand suggests that it may favour more sheltered conditions than *A. crinitus* (Pennant). The Scottish example measured approximately 30 mm. and on the basis of some preliminary observations on growth rate in chitons, Dr. Matthews tentatively considers that the example may be some years old; this could be of importance in relation to the ability of the species to maintain its northern range in very cold winters.

EXOTIC SPECIES. In the report to the 1968 A.G.M., mention was made of some mussels found at Fairhaven on the Ribble, Lancashire (C.A. 24, Liverpool Bay). At the time the recorder identified them as "probably *Septifer* sp." but further research by their finder, Mr. P. Cambridge, has disclosed them to be a West African species of *Congeria,* known to have been introduced into various European countries, including Holland. A full account of this interesting occurrence has been sent to the *Newsletter* by Mr. Cambridge.

Dr. V. Fretter has kindly checked various prosobranchs and pyramidellids: thanks are due to her and all those who have helped with the census in the past year. The recorder is particularly grateful to Mr. L. W. Stratton for once more presenting this Report.

Stella M. Turk

REPORT ON JUNIOR MEMBERSHIP 1968–1969

Membership. Seven new junior members have ben elected during the year but unfortunately several have resigned or been removed for non-payment of dues. Two juniors have become full members on reaching the age of 18. One junior has contributed to the *Conchologists' Newsletter*. The total junior membership to date is 26.

Publicity. The second in the series of new type folders published by the Society largely concerns junior membership and it is hoped will have a wide distribution. The British Museum (Natural History) has published a cyclostyled circular entitled "Young Naturalists—what you can do" and junior membership is mentioned, with some details, under the section "Join a National Society". As the age limits are not stated I have had a few applications for young people under 12 years of age.

Some recently published, and now widely distributed, books on Mollusca for young people have mentioned junior membership and this has been valuable publicity.

Papers for Students. No. 10 "The Care of the Collection" by Messrs. A. Blok and T. E. Crowley was published on 16 November 1968, and No. 11 "Collecting British Marine Mollusca" by Mrs. S. M. Turk on 18 January 1969. During the year four titles became out of print, but only one was reprinted. The others will be reissued as early as possible in 1969. The total income from sales this year has amounted to £10 1s. 0d.

H. E. J. BIGGS

854TH (ORDINARY) MEETING, 22 MARCH 1969

Communication. "A Reassessment of Species Described from East Africa by W. Blume" by Dr. B. Verdcourt.
Subject for Discussion. The Land Shells of England, introduced with a talk "A World's Eye View of British Nonmarine Shells" by S. P. Dance.

MEMBERS ELECTED

Igor Akerblom, Mannerheimvag 120, Helsingfors, Finland.
Lt. Cdr. Denis S. Cross, D.S.M., Broadway Cottage, Dursley, Gloucestershire.
J. S. Fleet, 30 Top Road, Kingsley, via Warrington, Cheshire.
Lancaster Cave and Mine Research Society, c/o P. Ashmead, 50 Vale Road, Lancaster.
T. H. Riley, B.Sc., A.M.A., F.G.S., 65 Crimicar Drive, Fulwood, Sheffield 10.
Anthony Michael Walton, B.C.L., M.A., 62 Kingsmead Road, Tulse Hill, London S.W.2.
D. R. Worth, 87 Mackenzie Road, Beckenham, Kent.
John Edward Yates, L.D.S., R.C.S., 16 Castle Street, Dumfries.

MEMBERS DECEASED

Capt. Cyril Driver, C.B., C.B.E., Past-President; A. G. T. Evans.

855TH MEETING

Held jointly with the Malacological Society of London, at the British Museum (Natural History) on Saturday, 26 April 1969.

Many exhibits were arranged for discussion, and the following lectures were delivered:

Dr. J. A. Allen, "Adaptations by Mollusca to Life in Deep Water Sediments".
Dr. M. P. Kerney, "Census Mapping of British Nonmarine Mollusca".
Dr. N. Holme, "Marine Mollusca and Pollution".
Dr. M. R. Clarke, "Cephalopoda found in the Stomachs of Whales".

A film was also presented by the Oxford Scientific Film Unit, the two parts entitled "Mollusca" and "Planktonic Larvae".

856TH (ORDINARY) MEETING, 17 MAY 1969

Communication. "Conchology and Archaeology" by L. W. Stratton.
Subject for Discussion. Fossil Mollusca from Overseas, introduced with a talk on the Preservation of Fossil Shells by P. E. Negus.

MEMBERS ELECTED

John Anderson, Bank House, 181 High Street, Epping, Essex.
J. B. Burch, Ph.D., Museum of Zoology, University of Michigan, Ann Arbor, Michigan 48104, U.S.A.
Earl of Cranbrook, C.B.E., Red House Farm, Great Glemham, Saxmundham, Sussex.
Brian Davis, 44 Hobbetts Road, Hemel Hempstead, Hertfordshire.
James Frederick Fogan, 181 New Brook Road, Atherton, Manchester M29 9HA.
G. A. Greiner, B.Sc., 117 Wanstead Park Avenue, London E.12.
P. B. Mordan, B.Sc., 4 Ridge End, Hook Heath, Woking, Surrey.
Miss K. M. Morehouse, B.Sc., M.Biol., 23 Queens Road, Doncaster, Yorkshire.
Mrs. M. Preece, Penrhyn, Baring Road, Cowes, Isle of Wight.
Jean Wuyts, Wetstraar 58, Antwerp, Belgium.

J. CONCH. *27*: 63 (1969)

PUBLICATIONS RECEIVED

Mollusques Venimeux (Extrait du Bulletin *Les Naturalistes Belges,* t.50, 1962, No. 4, by Maurice Lucas).

A useful summary of present knowledge on molluscs capable of secreting venom for offensive purposes, the paper naturally deals mainly with the Cones, but lists other genera known to secrete poison, including *Aplysia, Spondylus,* various Cephalopods, and *Limnaea peregra* which is capable, it seems, of narcotising small fish. A point is made concerning the Cones, that since the relative portions of the anatomy are very similar in all cases, all cones must be suspected of being capable of producing poison of some kind. M. Lucas concentrates on those known to be dangerous to human beings, describing the anatomy in some detail, and the method of employment of the very specialised radular tooth. He then examines the action and possible strength of the poison and the symptoms to be expected from a victim. In spite of the good bibliography appended to the paper it would seem that there is still a good deal to be found out about the subject of venomous molluscs.

T. E. CROWLEY

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3. Manuscripts must be submitted in finalized, fully revised and corrected form; proof corrections are expensive and should be restricted to typographical errors. All corrections in excess of this are liable to be charged to the author. It is a function of the Editor to maintain a standard of uniformity in the presentation of papers published in the *Journal*, and authors who submit papers implicitly acquiesce in his discretion in such matters; they are recommended to study the arrangement and conventions observed in the current number. Authors should retain a carbon copy of the manuscript.

4. Text-figures must be drawn in black Indian ink, preferably on Bristol board, and numbered consecutively in arabic figures. Figures are referred to in the text as 'Fig. 1', etc.; where there is also a plate containing several figures, figures in the text are referred to as 'Text-fig. 1', etc. Lettering may be left to the Editor, in which case the information should be lightly inserted in pencil. The position of text-figures, graphs and tables should be indicated in the margin of the text. Legends for figures must be typed on a separate sheet and not on the actual illustration.

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6. Tables should be kept to a minimum and be concise; they should be set out on separate folios and provided with headings. As far as possible, the headings should make the tables self-explanatory.

7. References should be listed alphabetically, the author's surname and initials being given. Quote the *full* title of the paper or book. Titles of periodicals should be abbreviated according to the *World List of Scientific Periodicals* (4th edition) with the exception that the *Journal of Conchology* should be abbreviated to *J. Conch.*, and the *Journal de Conchyliologie* to *J. Conchyliol.* Where the reference is to a book, the place of publication should be added, and the publisher if a Society or Institution.

8. Authors receive 25 copies gratis of all papers other than brief notes. Further copies may be obtained at cost price if ordered when galley proofs are returned. Joint authors share reprints; they do not receive 25 copies each.

Vol. 27 No. 2 April, 1970

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Field Meetings *Organizer:* T. PAIN, 47 Reynolds House, Erasmus Street, Millbank, London S.W.1.

Non-marine Census *Recorder:* M. P. KERNEY, B.SC., PH.D., Dept of Geology, Imperial College, London S.W.7.

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J. Conch. *27*: 65–86 (1970)

"LE FANATISME DU NOBIS": A STUDY OF J.-R. BOURGUIGNAT AND THE "NOUVELLE ECOLE"

S. P. Dance

Zoology Department, National Museum of Wales, Cardiff.

(Presidential Address delivered 17th February 1968)

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Introduction

Jules-René Bourguignat was born in 1829 and died in 1892.[1] Charles Darwin was born in 1809 and died in 1882. In the history of biology no two contemporaries could have been more different: Bourguignat was as incapable of writing *On the origin of species* as was Darwin the *Lettres malacologiques*; and for all his industry Bourguignat remains a lilliputian while Darwin's stature increases daily.

There is a reason for mentioning the two together here. The significance of *On the origin of species* is undisputed now; but its impact was not so explosive, not so immediately influential in some countries as in others. France, in particular remained indifferent, most of its leading biologists unconvinced, for a surprisingly long time, although the book was published there at least eight times between 1862 and 1882. This helps to explain why, during the turbulent initial stages of the Darwinian Revolution, it was possible for someone to promulgate a species concept totally out of step with Darwin's, to acquire a fairly substantial following, and through that following to push that concept, unchanged, into the twentieth century. Bourguignat had little regard for Darwinism, but neither, it seems, had many contemporary Frenchmen. Consequently, the most searching criticism of his work came from outside France, notably from Germany; French opposition came principally from those who disliked him personally. With some reservations it is reasonable to say that the opposition to Bourguignat in his own country was emotional, in Germany and elsewhere, philosophical. The full story of Bourguignat and the "nouvelle école" has not been told before, possibly because even now some of those best qualified to tell it cannot easily adopt a neutral stance.[2] Perhaps it is right that an Englishman should try to tell that story now, for the distressing effects of "le Bourguignatisme", though observed, were never felt in England.

---

[1] He was born at Brienne-Napoléon (now Brienne-le-Château), Aube, on 28 August 1829, and died at Saint-Germain-en-Laye, Seine et Oise, on 3 April 1892; he is buried at Vendeuvre-sur-Barse, Aube.

"Bourguignat seul"

In 1852, when his first malacological work was published, Bourguignat was 23 years old. At that time d'Orbigny and Deshayes were still alive; and Cuvier, Lamarck and Draparnaud, though dead, were omnipresent guiding spirits whose work represented (to their countrymen anyway) all that was best in malacology. It was excusable if the impressionable youth did not look beyond the confines of his own country for inspiration. But many lesser Frenchmen had dabbled in malacology and had produced an endless stream of articles and booklets describing and listing the molluscan faunas of various French Departments. By the middle of the century a voluminous and unwieldy literature had accumulated, much of it undistinguished. It was time for a man of energy, genius and boldness to bring order into the mounting chaos of French malacology. Bourguignat would be that man. He lacked genius, but energy and boldness he had in abundance.

Even before he appeared in print Bourguignat had become known to one or two French malacologists, Baudon[3] being an early acquaintance and Drouët[4] another.

> Drouët to Baudon, 11.vi.1852: "I am jealous of Bourguignat being able to visit you in Paris. He is a very young man possessed by la fièvre malacologique at the moment; undoubtedly this will subside. But today he is a little unruly."

Bourguignat was then only 22, and as Drouët was to discover "la fièvre malacologique" was more virulent than he supposed. In August 1852 Bourguignat

---

[2] A long paper dealing with the same subject has just been published by a Dutchman (Kuiper, 1969). Based on the Baudon correspondence it presents a more detailed, more intimate picture of Bourguignat than this address. Among other things it contains abundant material for anyone interested in the psychological aspects of this extraordinary man's behaviour.

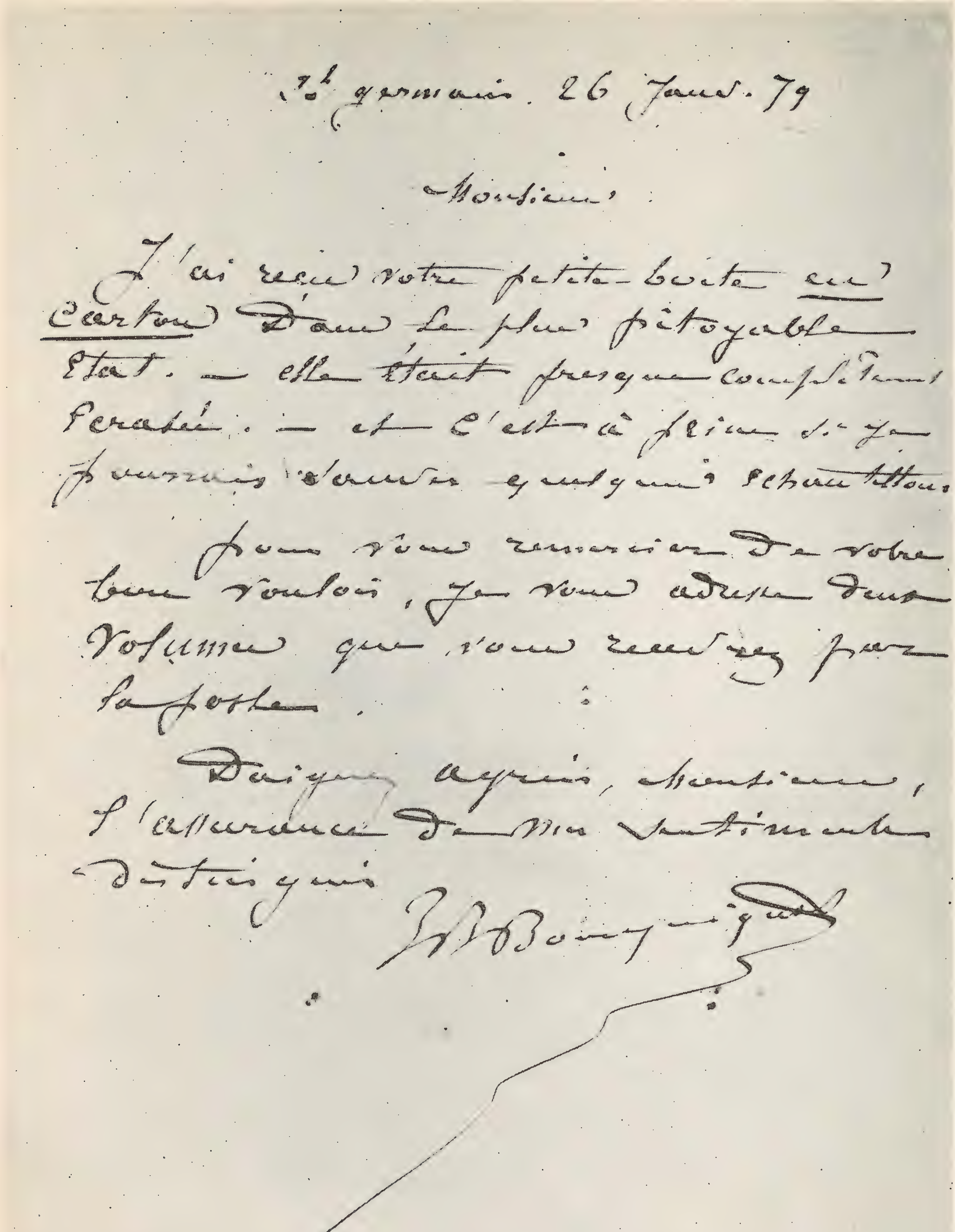
[3] Auguste-Adolphe Baudon (1821–1905) lived at Mouy, Oise, and was an enthusiastic and careful malacologist. He paid much attention to *Succinea* and *Pisidium* and wrote numerous excellent articles on these and other groups. He corresponded widely on malacological matters and nearly all the letters written to him over a period of 40 years have been preserved. Recently they came into the possession of J. G. J. Kuiper who, at my request, made extracts from them for my use. Their importance in the present context cannot be over-estimated. With few exceptions I have given free translations of those extracts I have utilized, words in square brackets being my own interpolations.

[4] Henri Drouët (1829–1900) went to school with Bourguignat and probably knew him as well as anyone did. Though critical of the species-making excesses of the nouvelle école he was something of a species-monger himself.

PLATE I

Top left. J.-R. Bourguignat; from a lithograph by A. Cholet, 1884. Top right. G. Servain; from a lithograph by E. Desmaisons, 1872. Bottom left. E.-A.-A. Locard; from a lithograph by A. Cholet, 1884. Bottom right. W. Kobelt; from a photograph, *ca.* 1905.

PLATE II



St germain. 26 Janv. 79

Monsieur,

J'ai reçu votre petite boîte en carton dans le plus pitoyable état. — elle était presque complètement écrasée. — et c'est à peine si je pourrais sauver quelques échantillons.

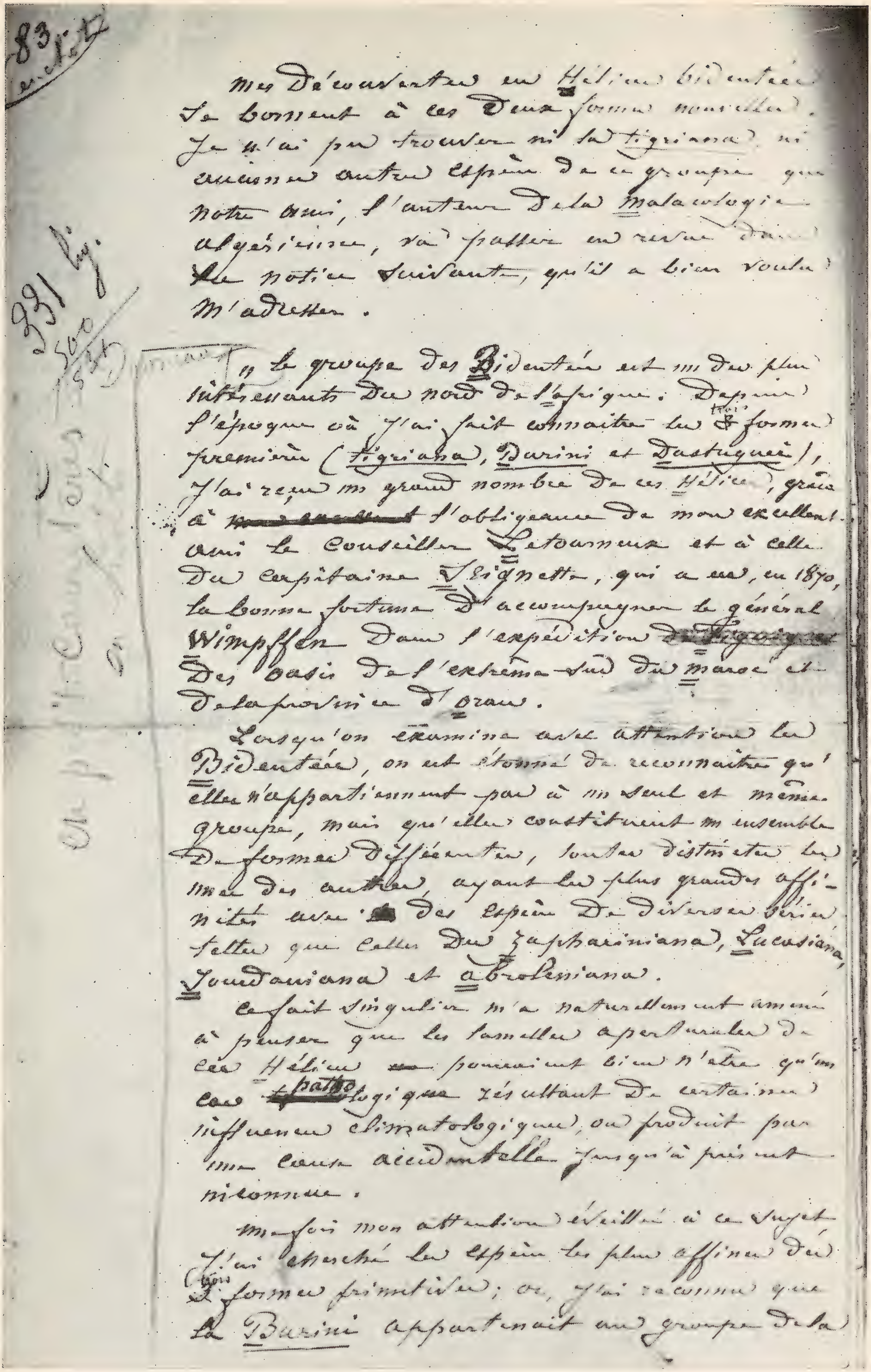
pour vous remercier de votre bon vouloir, je vous adresse deux volumes que vous recevrez par la poste.

Daignez agréer, Monsieur, l'assurance de mes sentiments distingués

JR Bourguignat

Holograph letter, dated 26. i.1879, from Bourguignat to an unknown correspondent (J. R. le B. Tomlin collection, National Museum of Wales).

PLATE III



83

231 lig.

Mes découvertes en Hélices bidentées se bornent à ces deux formes nouvelles. Je n'ai pu trouver ni la tigriana ni aucune autre espèce de ce groupe que notre ami, l'auteur de la Malacologie algérienne, va passer en revue dans la notice suivante, qu'il a bien voulu m'adresser.

« Le groupe des Bidentées est un des plus intéressants du nord de l'Afrique. Depuis l'époque où j'ai fait connaître les trois formes premières (Tigriana, Durini et Dastuguei), j'ai reçu un grand nombre de ces Hélices, grâce à ~~mon excellent~~ l'obligeance de mon excellent ami le Conseiller Letourneux et à celle du Capitaine Seignette, qui a eu, en 1870, la bonne fortune d'accompagner le général Wimpffen dans l'expédition ~~de Figuig~~ et des oasis de l'extrême-sud du Maroc et de la province d'Oran.

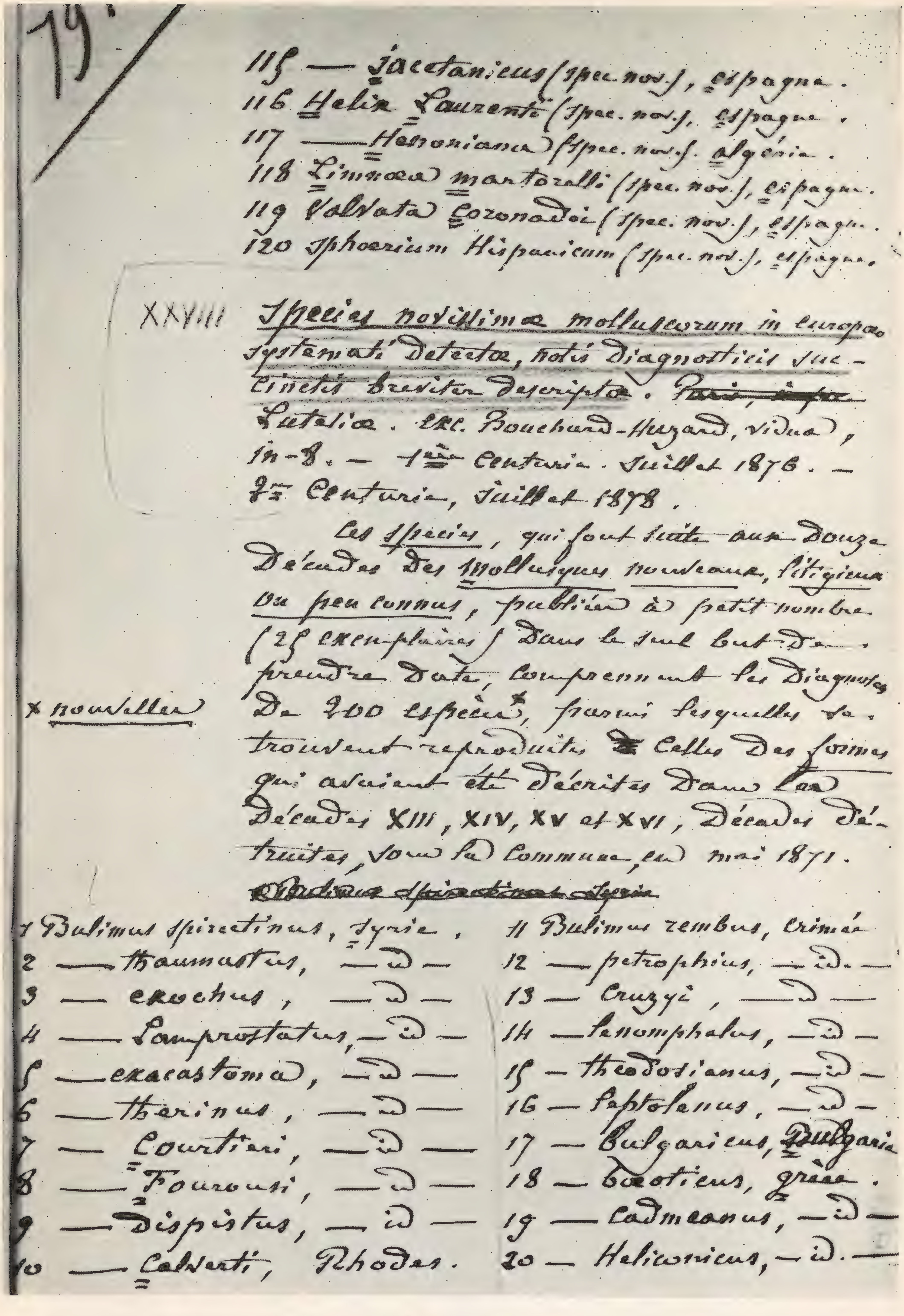
Lorsqu'on examine avec attention les Bidentées, on est étonné de reconnaître qu'elles n'appartiennent pas à un seul et même groupe, mais qu'elles constituent un ensemble de formes différentes, toutes distinctes les unes des autres, ayant les plus grandes affinités avec des espèces de diverses séries, telles que celles des Zapharíniana, Lucasiana, Joudaniana et Abrolesiana.

Ce fait singulier m'a naturellement amené à penser que les lamelles aperturales de ces Hélices ~~ne~~ pouvaient bien n'être qu'un cas pathologique résultant de certaines influences climatologiques, ou produit par une cause accidentelle jusqu'à présent méconnue.

Une fois mon attention éveillée à ce sujet j'ai recherché les espèces les plus affines des trois formes primitives; or, j'ai reconnu que la Durini appartenait au groupe de la

A page from the original manuscript of J. Péchaud's *Excursions malacologiques dans le nord de l'Afrique* (1883). Apart from the pencilled printer's instructions it is written entirely by Bourguignat.

PLATE IV



115 — jaccetanicus (spec. nov.), espagne.
116 Helix Laurenti (spec. nov.), espagne.
117 —— Hessoniana (spec. nov.), algérie.
118 Limnaea martorelli (spec. nov.), espagne.
119 Valvata Coronadoi (spec. nov.), espagne.
120 Sphoerium Hispanicum (spec. nov.), espagne.

XXVIII Species novissimae molluscorum in europaeo systemati detectae, notis diagnosticis succinctis breviter descriptae. ~~Paris, impr.~~ Lutetiae. Exc. Bouchard-Huzard, vidua, in-8. — 1ère Centuria, juillet 1876. — 2e Centuria, juillet 1878.

Les Species, qui font suite aux Douze Décades des Mollusques nouveaux, litigieux ou peu connus, publiées à petit nombre (25 exemplaires) dans le seul but de prendre date, comprennent les diagnoses de 200 espèces*, parmi lesquelles se trouvent reproduites celles des formes qui avaient été décrites dans les Décades XIII, XIV, XV et XVI, décades détruites, sous la Commune, en mai 1871.

* nouvelles

~~Bulimus spirectinus, Syrie~~

1 Bulimus spirectinus, Syrie.
2 — thaumastus, — id —
3 — exochus, — id —
4 — lamprostatus, — id —
5 — exacastoma, — id —
6 — tharinus, — id —
7 — Courtiani, — id —
8 — Fourousi, — id —
9 — dispistus, — id —
10 — Calverti, Rhodes.
11 Bulimus rembus, Crimée
12 — petrophius, — id. —
13 — Cruzyi, — id —
14 — lenomphalus, — id —
15 — theodosianus, — id —
16 — leptolenus, — id —
17 — Bulgaricus, Bulgaria
18 — boeoticus, grèce.
19 — cadmeanus, — id —
20 — Heliconicus, — id. —

A page from the original manuscript of *Oeuvres scientifiques de M. J.-R. Bourguignat* (1891). It is written entirely by Bourguignat (as is the rest of the manuscript) and proves that he is the author of the book. G. Servain, to whom authorship is usually credited, wrote the "Préface biographique" and nothing else.

published *Testacea novissima*, a 31-page tract describing a number of species he considered new to science which had been collected by C. de Saulcy in the Near East (Bourguignat, 1852a).

> Drouët to Baudon, 6.ix.1852: "I give up the moment Bourguignat arrives from Paris, always petulant, always creating new species.... Undoubtedly he has sent you his brochure on the new molluscs of M. de Saulcy.... Everywhere he sees nothing but new species! According to him Dupuy[5] has done nothing worth while; Deshayes[6] is an old fogy; and Moquin-Tandon[7] a blockhead...see how he treats our masters and leaders!"

In the same year he published two short papers in the *Journal de Conchyliologie* describing two supposed new species of *Pisidium* (Bourguignat, 1852b, 1852c). One of the species (*P. sinuatum*) was merely a malformed *P. casertanum* (Poli). Baudon (1853) questioned its validity and became the first of the many malacologists who were to doubt the omniscience of its author in print. Surprisingly, Bourguignat continued to correspond with him for a while and even expressed a wish to name a new *Pisidium* after him (but did not publish it).

> Drouët to Baudon, 2.ii.1853: "You speak to me of Bourguignat, my dear Baudon. I ought to tell you that to do justice to his studies and his acumen I have not much confidence in his knowledge concerning the genus *Pisidium.* I think that he has not yet studied it seriously enough, and that all he knows, at present, and all that he says, is necessarily superficial.... Bourguignat's Monograph will have been done too quickly, and by a young man wanting to see his name in print!"

Another group of molluscs he studied in his youth was the family Ancylidae which, similarly, was then little understood. He wrote several papers, described a few species, and attempted to classify all the known ones. Whatever merit this work had was immediately eclipsed by the episode which arose out of it: the *Ancylus* affair. It had a trivial origin. In his catalogue of *Ancylus*, published in the *Journal de Conchyliologie*, he placed *Ancylus capuloides* Jan in the synonymy of his own *Ancylus janii*; but he gave no reason for his action (Bourguignat, 1853a). Petit,[8] who considered that he was not justified in supplanting Jan's validly proposed name for one of his own, was informed privately by Bourguignat why he had taken this action: Jan's specific name was compounded of both Greek and Latin—and that was against the rules established by Linnaeus. In a supplementary note to the paper Petit pointed out that a great number of names then current would have to be suppressed if this argument were generally accepted—even Bourguignat's would not escape censure—and concluded by saying that if Bourguignat persisted with this practice it would so inconvenience students that they would be forced to ignore his works (Petit, 1853a). Shortly afterwards Bourguignat published his reason for the name-change (Bourguignat, 1853b). The *Philosophia botanica* of Linnaeus (1751) justified his action, and he quoted two of the "laws" set out therein: "Nomina generica, ex vocabulo graeco et latino, hybrida, non agnoscenda sunt", and "Nomina generica in *oides* desinentia, releganda sunt". "Conscientious naturalists" obeyed these rules, he said, and he was only doing likewise. This note was published in the *Revue et magasin de zoologie*, a publication edited by Guérin Méneville which was a rival to the *Journal* for malacological articles.

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[5] The Abbé Dominique Dupuy (1812–85), author of *Histoire naturelle des mollusques terrestres et d'eau douce qui vivent en France* (1847–52), a bulky work highly esteemed in its day.

[6] Gérard-Paul Deshayes (1796–1875), one of the all-time giants of malacology, author of countless books and articles, and after d'Orbigny's death, doyen of the science in France.

[7] Christian-Horace-Bénédict-Alfred Moquin-Tandon (1804–63), an outstanding zoologist and a pioneer of molluscan ethology. His *Histoire naturelle des Mollusques terrestres et fluviatiles de France* (1855–56) is larger even than Dupuy's and infinitely its superior. It is still a standard work of reference and in many ways has not been superseded.

[8] Sauveur Petit de la Saussaye (1792–1870), founder and first editor of the *Journal de Conchyliologie.* Apart from his contributions to the *Journal* he wrote several other articles and books on molluscs.

> Drouët to Baudon, 3.vi.1853: "It seems that Bourguignat is going to fill up all the journals with his rêveries ancylographiques. The next number of the *Revue* ... will contain a critical note by him on the *Ancylus capuloides*. It seems that the unfortunate M. Gassies[9] will be slaughtered."

Gassies was to pay dearly for criticising Bourguignat's handling of the *Ancylus* question (Gassies, 1855). In July 1853 someone signing himself "Henri Aucapitaine" published a review of the first two parts of the fourth volume of the *Journal* and criticised some minor errors made by Petit (Aucapitaine, 1853b).[10] He had published a favourable review of Bourguignat's *Journal* paper on *Ancylus* in an earlier number of the *Revue* (Aucapitaine, 1853a). Incensed by Aucapitaine's and Bourguignat's refusal to abandon his anomalous nomenclatural procedure ("sa malencontreuse doctrine" as he called it) Petit published a long article entitled "Les ennemis des Ancyles et du *Journal de Conchyliologie*" (Petit, 1853b). Once more he criticised Bourguignat for his cavalier treatment of the name *Ancylus capuloides* and pointed to certain inconsistencies in his writings. He was not content merely to condemn some of Aucapitaine's statements: he accused him of being Bourguignat's advocate and the latter of being the real author of some of those statements.

> Drouët to Baudon, 15.x.1853: "I saw Bourguignat the day before yesterday. He came up from the country to Troyes to read M. Petit's article. He wants to reply, and intends to crush his adversary. I believe that this lad, if he continues, will become insane. He won't leave my room and babbles incessantly. Since he was here I've been unable to write a word. The last time he came to see me (that was the day before yesterday) he was with one of his cousins. Both were as drunk as lords. After several minutes, the cousin was as sick as a dog in the middle of my room ... I have never seen a drunkard so ill. He was as pale as death, and was

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[9] Jean-Baptiste Gassies (1816–83), a competent malacologist best known for his published studies on the non-marine molluscs of New Caledonia.

[10] Aucapitaine also said that he could not sufficiently praise "the modest author of the *Ancylus* monograph" for the way in which he had expressed his views on the laws of nomenclature and the shameless violation of them by "le fanatisme du nobis"; this expression may be interpreted as "the fanatical desire to see one's name after a species" ("nobis"—of us—then being an expression often placed after a new taxon in a scientific publication; "mihi"—of myself—was also used). Whatever he may have preached it has long been taken for granted among malacologists that, in practice, Bourguignat was unrivalled in the pursuit of "le fanatisme du nobis": the title of the present address needs no further explanation.

> unable to move or speak. Bourguignat, who was smoking his 6th cigar, tapped him on the back, shook him, turned him round and threw water over him to revive him. . . . It is in the middle of this besotting life that the celebrated Bourguignat composes his famous articles."

Petit was no match for Bourguignat. In a letter to him dated 2 December 1853 Bourguignat pointed out that he did not know Aucapitaine; consequently the accusations were false. Meanwhile Petit had met Aucapitaine who had assured him that he was not in the least prejudiced against the *Journal*. Petit published the letter sent by Bourguignat (1853c), mentioned his meeting with Aucapitaine, and lamely assured his readers of his innocence throughout the regrettable affair; but it was too late. He admitted defeat and said that, as a gentleman, he had no alternative but to cease publication of the *Journal*; he was now looking for someone else to edit and publish it (Petit, 1853c). Bourguignat had triumphed. From then on almost anyone who contributed to the *Journal* (which began to appear again a year later under new editorship) was automatically an enemy, and that applied particularly to its editors.[11] It is probably no co-incidence that he adopted the expression *malacologie* in his subsequent writings. Always fastidious in his choice of words it would have seemed to him a subtle way to so distinguish his work from that published in a periodical devoted to *conchyliologie*.[12]

In August 1853 he began to publish in the *Revue* a series of short articles on various malacological subjects under the title *Aménités malacologiques*; these continued to appear until March 1860. He exploited Guérin's lax editorial policy and made full use of the hundred reprints of each article. He gathered together the first 50 articles, repaginated them, added a title-page, introduction, plate explanations and index, and in August 1856 published them in book form under the title *Aménités malacologiques*; a second volume comprising 35 articles, appeared in April 1860 (Bourguignat, 1853–60).

> Terver[13] to Baudon, 28.iii.1854 : "A propos Bourguignat, he has sent me two small articles, both entitled *Aménités Conchyliologiques* [sic]. I know of nothing more bitter, nor more pretentious than this opuscule. . . . When he has had 20 or 30 years of experience he will be, perhaps, more modest."

> Petit to Baudon, 3.iv.1854 : "If I can believe one of his friends, he has lately published in the *Revue* . . . an article in which he works you over a little; but what is more remarkable is that he has had reprints made in which you are treated still worse. I cannot vouch for the fact, having stopped taking the review which lends

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[11] J.-C.-H. Crosse (1826–98), who became one of its editors in 1861, seems to have retained his friendship, at least for a time, for he is referred to in 1864 as "notre ami Crosse" (Bourguignat, 1863–4, **2**: 301). No doubt Crosse's favourable reviews of several Bourguignatian works had something to do with this.

[12] I have dealt with the use and misuse of the expressions *malacologie* and *conchyliologie* elsewhere (Dance, 1966: 270–274). The latter expression now means to many persons what Bourguignat wanted it to mean: the study of shells (as opposed to the study of molluscs).

[13] Ange-Paulin Terver (1798–1875) of Lyon prepared many drawings to illustrate the writings of other men. The illustrations to A.-L.-G. Michaud's *Complément* to J.-P.-R. Draparnaud's *Histoire naturelle des mollusques terrestres et fluviatiles de la France* were all taken from his drawings and many of the shells depicted were from his collection.

> itself to these villainous manoeuvres for a dishonourable purpose; but if it is true, it shows still more disloyalty. . . ."

The anti-Baudon passage referred to by Petit occurs in *Aménités* X (Bourguignat, 1853–60, **1** : 43) where Bourguignat draws attention to a paper by Baudon on *Pisidium* and says: "Nous avons eu un instant la pensée d'analyser ce travail et d'en faire ressortir les nombreuses erreurs. Mais, en y réfléchissant, il nous a paru inutile de discuter d'une manier sérieuse cet article sans valeur."

> Drouët to Baudon, 14.iv.1854 : "If you wish to know the origin of M. Bourguignat's rancour against you, it is because of your article on the *Pisid*[*ium*] *sinuatum* : nothing more! Bourguignat can't stomach anyone who criticises what he's done."

In 1853 a Chair of Paleontology was created for the first time in the Muséum Nationale d'Histoire Naturelle at Paris; d'Orbigny, then 51 years old, was chosen to occupy it. The choice was an obvious and natural one: not so that of his Preparator.

> Drouët to Baudon, 11.xi.1853: "Do you know that Bourguignat is nominated Preparator to M. Alc. d'Orbigny, Prof. of Paleontology at the Museum? . . . The other day, last week, Bourguignat, proud of his new title, came straight from the country to my study. He was as beautiful as a star. He swam in velvets and perfumes. Are you getting married?, I exclaimed on seeing him.—For his sole response he gravely showed me his certificate of recommendation from the President of the Board of Education. Voilà la nouvelle du jour."

According to Ancey (1892), he was "appelé par . . . d'Orbigny, à la place de préparateur . . . place qu'il conserva jusqu'à la mort de ce savant illustre, dont il fut l'aide et l'ami." It is not known how d'Orbigny came to know of him, nor why he chose him to be his personal assistant. Five years close contact with an eminent scientist could hardly fail to make a deep impression on Bourguignat whose approach to nomenclature, in particular, owed much to d'Orbigny. A year or two after d'Orbigny died Bourguignat relinquished his post as Preparator (to be succeeded, in 1861, by P. Fischer (1835–93) towards whom he maintained a life-long and intense dislike). From then on he devoted the rest of his life to his studies. He had plenty of opportunity to do so, for he does not seem to have needed to work for a living.

While at the Museum he was able to pursue his many interests. He travelled, collected, wrote, published; he even found time to marry. At the same time he continued to alienate himself from the main body of French malacologists. He was, by now, insufferable and his scientific work was being regarded with suspicion and disdain. In their correspondence his enemies swapped anecdotes about him: he was now a menace to science, now a bore, now a clown, now a charlatan.

> Drouët to Baudon, 10.ix.1854: "Bourguignat is at Troyes at the moment. He overwhelms me with his visits, from 9 in the morning to midnight. Not a moment of respite. It is so tedious!"

> Drouët to Baudon, 4.iv.1855 : "Messire [ironical for 'Gentleman'] Bourg. arrived yesterday. He is always the same, perhaps worse. We are all asses, there's no one learned but he; at last he is a doctor. Voilà the trend of all his conversations, if

> one may so call diatribes without end. . . . You are by no means forgotten. That man is bile personified."
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> Mortillet[14] to Baudon, 24.vii.1858 : "A propos of Bourguignat, the other day. . . . I met at Livourne a young Frenchman travelling for pleasure. . . . He told me he was from Bordeaux : naturally I spoke of Grateloup.[15] He [Grateloup] was his family's doctor, and he praised him to the skies. Then, when he understood that I knew of him as a naturalist, he asked me if I also knew Bourguignat. He had met Bourguignat in Naples. He was in the same hotel. M. Bourguignat, to alleviate the grief caused by the loss of his wife,[16] was travelling with his father-in-law, . . . his mother-in-law . . . and a young friend of the family . . . Bourguignat talked as much as he could, gave himself the airs of an artist and bought indifferent paintings which he esteemed as overlooked masterpieces. He was the delight of the cunning Jews of the country. As to French naturalists he set little value on them. Grateloup is nothing but a driveller, Moquin-Tandon a compiler without merit etc."
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> Daniel[17] to Baudon, 8.viii.1859 : "He seems to me to make more species than the Creator has distributed on earth. . . ."
> Daniel to Baudon, 3.x.1859 : "Already I have a kind of repulsion towards him; his verbiage, his assurance, his bragging has offended me terribly."

From 1860 to 1864 Bourguignat was very active. His *Aménités malacologiques* having been terminated he began a new series of articles in the *Revue*, and these were collected and re-issued under the title *Les Spicilèges malacologiques* (Bourguignat, 1860–62). In 1863 he began yet another series in the *Revue* comprising articles devoted to descriptions of supposed novelties and doubtful or little-known species. These were collected and re-issued under the title *Mollusques nouveaux, litigieux ou peu connus* (Bourguignat, 1863–70). Meanwhile he was at work on his magnum opus.

Ever since he had studied the collections made by de Saulcy in the Near East Bourguignat had been interested in the molluscs of the arid or semi-arid regions to the east and south of the Mediterranean; and much material from these regions had been placed in his hands for study and report. His *Paléontologie des mollusques terrestres et fluviatiles de l'Algérie* (Bourguignat, 1862) was the prelude to a much larger work, the one by which he is now best known: the *Malacologie de l'Algérie* (Bourguignat, 1863–64). Described by himself as a "magnifique ouvrage, édité avec le plus grand luxe" (Bourguignat, 1891 : 91) it is, indeed, an impressive book. The lithographed illustrations by Levasseur and Arnoul contribute most of the "luxe". It had few detractors when it was published and it was praised highly by one or two eminent malacologists; those who thought its author a menace to science were silent for once. The six fascicules in folio which comprise the complete work appeared at intervals between May 1863 and December 1864 (Dance, 1968). Reviewing the sixth fascicule in 1866 Crosse said: "Au résumé la *Malacologie de l'Algérie* constitue un bel et important ouvrage . . . qui a augmenté, dans une proportion notable, la somme de nos connaissances sur les mollusques du nord de l'Afrique. Le grand luxe de la publication est un attrait de plus pour les bibliophiles . . ." (Crosse, 1866). No other Bourguignatian work received such an accolade: it was the high-water mark of its author's career. One man affected not to have noticed it.

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[14] Louis-Laurent-Gabriel de Mortillet (1821–98), a keen shell collector, lived for many years at St. Germain-en-Laye (where Bourguignat lived from 1871).

[15] Jean-Pierre-Sylvestre de Grateloup (1782–1861), eminent naturalist of Bordeaux. He published on fossils mainly but had a wide knowledge of living molluscs too. As he drew nearly all the illustrations for Draparnaud's *Histoire naturelle des mollusques* it is surprising that Bourguignat did not venerate rather than denigrate him.

[16] The marriage must have been brief as Bourguignat was then only 29. It is possible that he inherited a lot of money and/or property from his wife as he seems to have lived in style subsequently. He was twice married and twice bereft.

[17] Félix Daniel (1820–89) of Brest had a large shell collection and wrote on molluscs of his neighbourhood.

> Drouët to Baudon, 19.x.1865: "I am just reviewing the various malacological works published since 1861. The celebrated Bourg. is represented by no less than 8 to 10 publications. What rubbish!"

"La nouvelle école"

Bourguignat's talent for making enemies did not prevent his making friends too. From now on he had the sympathy and often the unswerving loyalty of a number of persons who were content to play satellite to his sun. One of the first to come into orbit was Alcide Paladilhe (*d.* 1877) whose *Nouvelles miscellanées malacologiques* has frequent references to "notre excellent ami Bourguignat" and shows unmistakable signs of Bourguignatian influence throughout (Paladilhe, 1866–69). The nature of that influence was clear to Gassies when he read, under the description of *Valvata minuta*: "C'est M. Gassies qui a commencé à égarer, suivant son habitude, les naturalistes sur la valeur des caractères de cette espèce, en décrivant, sous le nom de *minuta*, une charmante Valvée microscopique de forme globuleuse. Depuis, les malacologistes, en accordant trop de confiance aux pauvres déterminations de l'auteur des Mollusques de l'Agenais, n'ont fait que suivre la même erreur" (Paladilhe, 1866–69: 25). Gassies published a letter in the *Revue* for 1866 demanding to know who had written these words and asking for a retraction. Bourguignat hastened to reply, but in a novel way. In January 1867 he published a 19-page "letter" addressed to Gassies (Bourguignat, 1867); it is probably the most nauseating document ever published by a malacologist (those he addressed to Brusina and Kobelt fourteen years later, though unpleasant too, at least contained scientific information of some permanent value). Its sole purpose was to humiliate Gassies by criticising minor errors in his publications. To add force to his statements and to make the humiliation of Gassies complete Bourguignant incorporated facsimile reproductions of letters written by Gassies and others. Gassies was not merely humiliated: he was crushed. The letter left him with the impression that he could not trust any of his former friends; Bourguignat had used their own words to demolish him. Years later Gassies was still suffering.

> Gassies to Baudon, 24.x.1874: "I have promised myself to make no more exchanges [presumably of shells] so well has my polemic with Bourguignat shown me the weakness of most of my correspondents. . . ."

Probably his polemic with Bourguignat was the principal cause of a marked decline in his health; and all because he had dared to intervene in the "*Ancylus* affair": Bourguignat did not forget, could not forgive.

Mabille[18] was the most forceful of the early adherents to Bourguignat's views. In February 1867 he published in the *Revue* the first of a series of articles which he later issued as *Archives malacologiques* (Mabille, 1867–69). In the first part he referred frequently to Bourguignat and always reverently; named a slug after Paladilhe, "savant conchyliologue de la nouvelle école malacologique de France" (probably the first published reference to the nouvelle école); and, in quite a different vein, to a work on slugs by Morelet: "Dans ce travail de bien petite érudition scientifique, comme dans tous ceux que cet auteur a publiés, il existe sur les Limaciens des erreurs sans nombre" (Mabille, 1867–69: **I**, 6).

> Drouët to Baudon, 6.x.1867: "I have reflected on M. Mabille. I have not written to him, and I will not write to him. His brochure . . . gives me little confidence. He abuses M. Morelet in the most shocking way, and praises his leader [Bourguignat] beyond all measure. . . . Even now there is a general outcry against them [the nouvelle école] not only from France but abroad. I have received a good number of letters from Germany, from Belgium, from Switzerland and from Italy, where they think very little of them."

In 1868 Bourguignat published his *Histoire malacologique de la Régence de Tunis* (Bourguignat, 1868a). This was based on material he had collected himself during a short visit to that country and is noteworthy for its brevity: he was not cut out to be a field worker in places where the terrain was rough, the amenities crude, and he collected very little, as he says in his Introduction. In future he would rely entirely on more seasoned travellers for his materials to study. He would reap no rewards, win no medals or honours by tramping through dusty, inhospitable countries looking for shells; he would do better to stay in his study working on shells sent to him by others. Early proof of this came in 1869.

> Mortillet to Baudon, 20.ix.1869: "Were you not greatly moved, on reading the *Journal Officiel* of 15th August. The illustrious Bourguignat decorated as one of the most brilliant representatives of French science!"

These were happy days for Bourguignat. Publishers were kept busy producing his books and papers; he was slowly gathering a band of followers around him who looked upon him as their leader, their "Grand Maître" as they called him; and honours were beginning to come his way. Then disaster. A very proud man, he had a genuine and high esteem for his country, and anything which tended to diminish "la gloire" offended him personally. He had been incensed by the conflict with Italy over the Savoie question, but by 1870 a much more serious problem had presented itself: the Franco–Prussian War, ending in humiliation and defeat for France and leading to civil war in Paris. The civil war culminated in the atrocities committed under the Commune in 1871 and Bourguignat was appalled and disgusted. His personal losses during that awful time, when men, women and children were dying of starvation or were being executed out of hand, seem to have been purely literary; in May 1871 the four concluding parts of his *Mollusques nouveaux, litigieux ou peu connus* were destroyed before they could be distributed. That, the loss of one or two other minor works of his, and the successes of the revolutionaries (whom he loathed) affected him deeply. He is said to have vowed not to publish anything more until the old regime should be restored; when it became evident that this was not going to happen in the foreseeable future he relented and, about 1878, began to issue his works as industriously as ever (Dollfus, 1901 : 329). This is only partially true as the list of his publications shows several entries between 1871 and 1877 (Dance, 1970). Another consequence of these disturbances was the addition to the ever-growing list of his enemies of most Italians and Germans and all pro-revolutionists. It also gained him a most useful friend : Georges Servain (*b.* 1846 *d.* ?). Seventeen years younger than Bourguignat, wealthy and arrogant, Servain had suffered more than had Bourguignat during the days of the Commune, and as he was like Bourguignat in many ways the two men became friends and allies. He had founded the journal *Annales de malacologie* in 1870 but publication had stopped almost immediately because of the troubles; it did not re-appear until 1884. Bourguignat was no pauper but Servain's money, as well as his personal support, probably did much to assist his cause.

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[18] Jules Mabille (1831–1904), one of Bourguignat's most fervent supporters, described many new "species" and specialised on slugs.

"Aux prises avec Kobelt"

So far no-one had had the courage to combat the views of Bourguignat and his satellites in print. Wilhelm Kobelt (1840–1916) of the Senckenberg Museum, Frankfurt, became the first to do so with the publication of his *Catalog der im europäischen Faunengebiet lebenden Binnenconchylien* (Kobelt, 1871). In the Foreword he criticised the excessive species-making of the nouvelle école and raised a question, in the light of the recent work of Darwin : what is a good species? In Kobelt's view many of the so-called species described by Bourguignat and others were only varieties. However uncomfortable this must have made him feel Bourguignat did not retaliate immediately; perhaps his vow not to publish anything after 1871 enforced silence. Realising that he would have to use tactics different to those used against Petit he attacked Kobelt's own published work. From 1876 onwards Kobelt edited the continuation of Rossmässler's *Iconographie* (Rossmässler, Kobelt *et al.*, 1835–1920); Bourguignat made this his target. Between 1880 and 1881 he published an extensive study of European Unionidae : *Matériaux pour servir à l'histoire des mollusques acéphales* (Bourguignat, 1880–81). Scattered throughout its pages are references to "l'auteur des suites à Rossmässler" (he rarely referred to Kobelt by name) and always to show that his illustrations were wrongly identified or poorly drawn. Bourguignat and Kobelt were now at war.

In a new edition of his *Catalog* Kobelt attacked the ideas of Bourguignat and the nouvelle école again (Kobelt, 1881). Having said that he had listed only those species of the nouvelle école which he was not able to class as other species, he continued: "Even the most attentive malacologists can overlook the papers of Bourguignat and his students, for the great species manufacturer at St. Germain-en-Laye publishes only for his friends—'c'est pour eux seuls que j'écris'—does everything possible to ensure that 'les adeptes de cette triste école [the ancienne école]', do not get their hands on his papers. For everyone who, like me, does not have the honour to be considered one of his friends, it is difficult to get his publications which follow each other so rapidly. Still more difficult is it, of course, to form an opinion on his published species. Formerly M. Bourguignat's papers were well illustrated; recently he has given this up, because even the best artists are unable to fix with a pencil differences which are distinguishable only by his philosophical eye. So one is committed entirely to the Latin diagnoses which mostly are as long as they are meaningless. Original specimens are hard to come by even for his friends. One of his students, to whom I recently applied for type specimens of Bourguignat's species of a local fauna, regretted not being able to send them because 'la plupart des espèces de M. Bourguignat sont presque toutes rares'" (Kobelt, 1881: v–vi).

Now it was Servain's turn. In a publication on the freshwater bivalves of Frankfurt (Kobelt's home town and headquarters of the German Malacozoological Society) he spoke up in Bourguignat's defence (Servain, 1882). After commenting on the "second-rate display" of local molluscs in the Senckenberg Museum he went on to criticise Kobelt: "We know that this author has done all he can up to the present to misconstrue the species established by our learned friend Bourguignat, and that up to now he has been reproducing in an inexact manner the beautiful figures which embellish the works of the French author to elicit false and arbitrary conclusions. . . . Our learned friend has been so indignant at the way the majority of his figures have been copied that he promises not to give illustrations of any more European species." Bourguignat no longer provided illustrations, he said, because he didn't want to make a rod for his own back through the dishonesty or lack of judgment of persons like Kobelt (Servain, 1882: 14).

By now few if any editors would allow Bourguignat to publish his polemical writings in their periodicals and so he had to utilize his own publications and those of his friends. In 1883 he seized the opportunity to continue his feud with Kobelt in a publication credited to another of his disciples, Jean Péchaud (1823–86). Entitled *Excursions malacologiques dans le nord de l'Afrique* (Péchaud, 1883) it comprises 112 pages, the last one petering out in the middle of a sentence; about half of it must be credited to Bourguignat (his contributions being picked out in a smaller type face and acknowledged in Péchaud's prefatory note to be by Bourguignat). As Péchaud was still alive when it was published there should be no reason to doubt that he had incorporated Bourguignat's notes as stated. There is one substantial reason for believing otherwise: Connolly (1934) has stated that "the entire MS of Péchaud's memoir . . . is in Bourguignat's own handwriting". This manuscript, together with others written by Bourguignat, is now in the Muséum d'Histoire Naturelle, Geneva (the repository of his personal library and most of his collections), and a page from it is reproduced here (Pl. 3). Comparison with other Bourguignat holographs (Pls. 2, 4) shows that it is a typical example of his handwriting. The pencilled printer's instructions to the left indicate a passage to be set up in small type. Bourguignat could have composed the whole thing—even the prefatory note with glowing reference to himself is in his handwriting—without Péchaud seeing it before it went to press. Consequently it was possible for him to publish condemnatory remarks upon Kobelt's work intercalated with Péchaud's text and apparently introduced with Péchaud's consent. Many new taxa were introduced in the book, although for most of them there is given a reference to "spec. noviss." followed by a number in excess of 100 and the date "1878". In every instance, however, these taxa were first validly proposed in Péchaud's memoir, the "spec. noviss. 1878" being a literary ghost (Connolly, 1934).[19] Bourguignat's intercalations were full of criticisms of Kobelt and the "suites à Rossmässler". In his treatment of certain helicids Kobelt had reduced several so-called species to varietal status but had illustrated them under their specific names; this attempt to please both the nouvelle and ancienne écoles had only demonstrated his ignorance once more: "il n'est pas possible, en effet", said Bourguignat, "d'accumuler, en aussi peu de pages et de figures, un si grand nombre d'erreurs".

In December 1882 there appeared another of Bourguignat's privately published *Lettres malacologiques*; one letter was addressed to Kobelt and two to Brusina[20] (Bourguignat, 1882). The letter to Kobelt is as vitriolic as it is pathetic. He was accused of pillaging Bourguignat's works to illustrate the *Iconographie*; he was told that so long as that publication was in progress Bourguignat would not publish another illustration of a European species; nor would he let any Bourguignatian species fall into his hands. If Bourguignat had committed errors in his publications none were so outstanding and so phenomenal as Kobelt's, particularly those in his *Inconographie*: "Votre ouvrage est, sans contredit, le travail le plus mauvais qui ait été publié depuis un siècle". Bourguignat concluded by saying that he was about to publish a work devoted entirely to the blunders and errors of identification committed by Kobelt. He promised to have it printed in large numbers and to distribute it widely, especially among Kobelt's friends.[21]

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[19] In 1876 Bourguignat had published an 80-page brochure entitled *Species novissimae molluscorum in Europaeo systemati detectae* (Bourguignat, 1876); only 25 copies were issued. This contains descriptions of a hundred supposed novelties numbered from 1 to 100. By 1878 he had prepared another brochure, similarly titled, containing a further hundred and numbered from 101 to 200; but it was never published. Apart from references to it in Péchaud's memoir and the works of one or two other Bourguignatians, it is cited in the *Oeuvres scientifiques de M. J.-R. Bourguignat* (Bourguignat, 1891) together with a list of the species supposedly described in it. Once again, though now it may come as no surprise, the manuscript of the *Oeuvres*, also in the Muséum d'Histoire Naturelle, Geneva, can be shown to be in Bourguignat's handwriting (Pl. 4). Servain (who is usually credited with its authorship) merely wrote a "préface biographique".

[20] Spiridion Brusina (1845–1908), Director of the Zoological Museum at Agram, Croatia, and author of many works on the molluscs, particularly fossil forms, of south-east Europe. The letters addressed to him answered his criticisms of Bourguignat's *Etude sur les fossiles tertiaires et quaternaires de la Vallée de la Cettina* (Bourguignat, 1880). Subsequently Brusina, playing him at his own game, published a long article in which he reproduced some letters to and from Bourguignat and made many unfavourable comments on him and the nouvelle école. (Brusina, 1884).

He was now the *bête noir* of European malacology. He had a number of disciples it is true, but few were prominent malacologists and most of them leant heavily on him for support and encouragement. Somehow he had to unite them around him effectively and obviously. On 1 January 1884 the Société Malacologique de France was formed. The founder-members were Ancey,[22] Bourguignat, Coutagne,[23] Fagot,[24] Hagenmüller,[25] Letourneux,[26] Locard (see below p. 80), Mabille, Poirier,[27] Rochebrune,[28] Saint-Simon,[29] and Servain. It is probably the most exclusive malacological organisation ever formed. The first number of the Société's official organ, *Bulletins de la Société Malacologique de France*, begins with a sort of manifesto, entitled "Aux Malacologistes", which is full of chauvinistic claptrap. It ends with a discussion of the species problem and a re-statement of the "nouvelle méthode". Then follow the Statutes of the Société some of which make interesting reading: Article 4—the Société shall comprise twelve French founder-members and an unlimited number of associate-members, French and foreign; Article 10—the President, Vice-President and the Secretaries are elected for a five-year period, the "Secrétairé général" only is elected for life; Article 16—no proofs are supplied to authors as everything will be revised and corrected by the secretaries. The Secrétairé général, of course, was

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[21] The verso of the back wrapper to the 1882 *Lettres* carries the following advertsisement: *Errorum in Kobeltanis operibus promulgatorum synopsis, ou relevé critique des erreurs, des inepties, tant spécifiques que synonymiques, contenues dans les oeuvres de M. Kobelt, de Francfort. Par M. J.-R. Bourguignat. Pour paraître en Janvier,* 1884, *la première centurie.* Another literary ghost, it was obviously advertised to intimidate Kobelt.

[22] César-Marie-Félix Ancey (1860–1906), an admirer of Bourguignat who described hundreds of non-marine molluscs from all over the world.

[23] Georges Coutagne is unique among this list of founder-members as his studies on polymorphism in land snails led him to denounce Bourguignat's approach to systematics. His published work would repay careful study by students of polymorphic land snails even today.

[24] Paul Fagot (1842–1908), author of many papers on the non-marine molluscs of the Pyrenean region, was a friend of Bourguignat's but was not afraid to disagree with him.

[25] P. Hagenmüller (*d.* 1900), had a large collection of non-marine molluscs, principally from Europe, but published little.

[26] Aristide-Horace Letourneux (1820–81), without whom Bourguignat would have been hard pressed for material to describe, was an untiring and intrepid collector who did more than anyone else in his day to show that many species of non-marine Mollusca lived in apparently barren countries, such as Algeria and Egypt. According to an anonymous biographer (almost certainly Bourguignat) he was, of all the members of the Société Malacologique, the one who had contributed the most, by his numerous journeys and ceaseless researches, to extend the domain of malacology (Anon, 1885–86: **2**: 1).

[27] Justin Poirier (*b.* 1849 *d.* ?), an authority on trematodes as well as molluscs, published detailed anatomical studies of marine gastropods.

[28] Alphonse-Trémeau de Rochebrune (1836–1912), a man of remarkable industry, published numerous malacological papers in which he described many new species collected mostly in and around the then French colonies.

[29] Guillaume-Camille-Alfred de Candie de Saint-Simon (1823–95), a pupil of Moquin-Tandon's, published many papers on molluscs and made a special study of the genus *Pomatias*.

Bourguignat. The Société was a vehicle for the propagation and even the enforcement of "le Bourguignatisme" through the medium of its publications. That Bourguignat made full use of his dictatorial powers is obvious in each volume of the Bulletins: "il usait et abusait de l'article du règlement que nous avons cité [Art. 16] et qui donnait tout pouvoir au secrétairé général" (Dollfus, 1901).

"Chant du cygne"

Until the contretemps with Kobelt it had been the malacological fauna of France (of which Algeria was then an integral part) and Western Europe upon which Bourguignat had lavished most attention. Hoping to avoid criticism he now turned to other, malacologically virgin, territories where, perhaps, Kobelt would not pursue him: Central and East Africa. The fauna of the great lakes, Uganda, Victoria, and especially Tanganyika, received particular attention. Achille Raffray's material, collected throughout Abyssinia in 1881, was the basis of the *Histoire malacologique de l'Abyssinie* (Bourguignat, 1883), in several ways one of his better works. The species he described as new to science could now be illustrated once more—being non-European and consequently of no use to Kobelt—and so his artists were busy again. Previously no-one had had access to anything like the numbers of specimens which now came into his hands, and anyone acquainted with the molluscs of Lake Tanganyika can appreciate his feelings as he opened up the boxes sent to him. Never before had he seen such a bizarre collection of shells from an inland lake; if ever a fauna were tailor-made for him it was this. Others had described novelties from there before but they had only pecked at the total fauna: he would gobble it up. For he was now elderly and this was to be his swan song. He could conjure up dozens of novelties from an average European lake or make 20 species out of a well-known European freshwater mussel: he would work miracles with the thalassoid[30] molluscs of Lake Tanganyika. If he was soon to be interred in the family grave at Vendeuvre "le Bourguignatisme" would live on in the waters of Lake Tanganyika.

In 1885 and 1886 he published some preliminary papers in which he described many novelties and proposed numerous new genera. Of 95 "species" collected by Giraud alone he described 75 as new, and proposed nine new genera at the same time (Bourguignat, 1885). On the pretext of helping the missionaries in Africa to acquaint themselves with all the described species from the lake he issued his *Iconographie malacologique des animaux mollusques fluviatiles du Lac Tanganika* (Bourguignat, 1888). By far the greater number of the "species" illustrated had been described as new by him. These works were the prelude to his final masterpiece, the *Histoire malacologique du Lac Tanganika* (Bourguignat, 1890). This was to have been completed in two parts, of which only the first was published, and is devoted to lengthy descriptions of species, most of them described originally by him. It is a hymn to "le Bourguignatisme"; it was his last contribution to the cause of the nouvelle école—*his* cause. No-one could accuse him of not providing illustrations of his Tanganyika shells; but they mostly illustrated species "distinguishable only by his philosophical eye"; they proved that Kobelt was right.

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[30] A term, first coined by Bourguignat, which is applied to any non-marine organism having a morphological resemblance to a marine organism.

> Drouët to Baudon, 22.iv.1892: "The news of the day, in the conchological world, is the death of that dreadful fellow Bourguignat. . . . The Bar-sur-Aube newspaper, which devotes a few lines to his obituary, says: at his funeral was seen a group of firemen, a gymnastic society, and the band of Amance.[31] The article naturally represents him as a phoenix and as one of the greatest naturalists of modern times. For me, who was his school-fellow, I know that he was never more than a good-for-nothing, who had not even been able to get his bachelor-of-letters. He never knew how to spell.[32] And for all the malacologists of France and Navarre he has never been anything but a mischief-maker, and a swindler. Thanks to him and to Locard (who is even more worthless), voilà conchology has become an inextricable chaos, with which no-one will wish to occupy himself any more."

Predictably, most of the obituary notices published in scientific journals were uncomplimentary, particularly about his species concept (e.g. Kobelt, 1892; Crosse, 1893). On the other hand J. W. Taylor, editor of the *Journal of Conchology*, was an admirer (and, one suspects, a would-be imitator[33]) of Bourguignat—an honorary member of the *Conchological Society of Great Britain and Ireland*—and was happy to publish a glowing tribute received from Ancey (1892). Of course Ancey was bound to extol the merits of his late master, but he was not bound to say that Bourguignat had "nombreux amis dévoués, qui avaient pu apprécier sa constante bienveillance, sa libéralité et son grand désintéressement scientifiques". It is hard to believe that this could be said of the author of *Lettres malacologiques*: impossible not to believe that it was said sincerely.

"Locard seul"

Bourguignat was dead. But nearly all his disciples still lived, and his mantle fell on the shoulders of the most fervent of them: Locard.[34] While the others, deprived of their leader, drifted into justified obscurity or became reconciled with the ancienne école he espoused the cause with redoubled energy. Even before Bourguignat's death Locard had begun to revolutionize the molluscan fauna of France. This was particularly apparent in his treatment of the Unionidae to which family he added hundreds of new "species" from France alone. His willingness to adopt Bourguignat's method of mensuration of unionids, which obviated the need for illustrations, became an added obstacle to the already nearly impossible task of identifying them[35] (Fig. 1). His revisions of *Margaritana* and

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[31] A necrology appeared in *L'Echo de l'arrondissement de Bar-sur-Aube*, 14 April 1892. Drouët misrepresents the tone of the article completely. Bourguignat, like his father before him, was much respected by the inhabitants of Vendeuvre-sur-Barse and Amance. He was a benefactor of the band of Amance, and the musical society of that village owed its existence to him. He also befriended the poor of both villages and by his will left 600 francs to be divided between them. In the *Bulletin Vendeuvrois* for 10 April 1892 there is a much longer necrology; it over-emphasises his scientific achievements but pays obviously sincere homage to a man much loved for his generosity and kindness. It also records that, in the year before he died, he was afflicted with a "terrible illness" which killed him slowly (Anon, 1892).

[32] Perhaps Drouët is recalling childhood memories here. Bourguignat may not have shone at school but he picked up later on. To say that he never knew how to spell is both untrue and unkind.

[33] Each of the species discussed in his well-known *Monograph of the land and freshwater Mollusca of the British Isles* is associated with a malacologist. To him Bourguignat was "a man of marvellous industry, a keen collector and prolific writer, with remarkable powers of exact discrimination and description of conchological differences." (Taylor, 1908: 118–9).

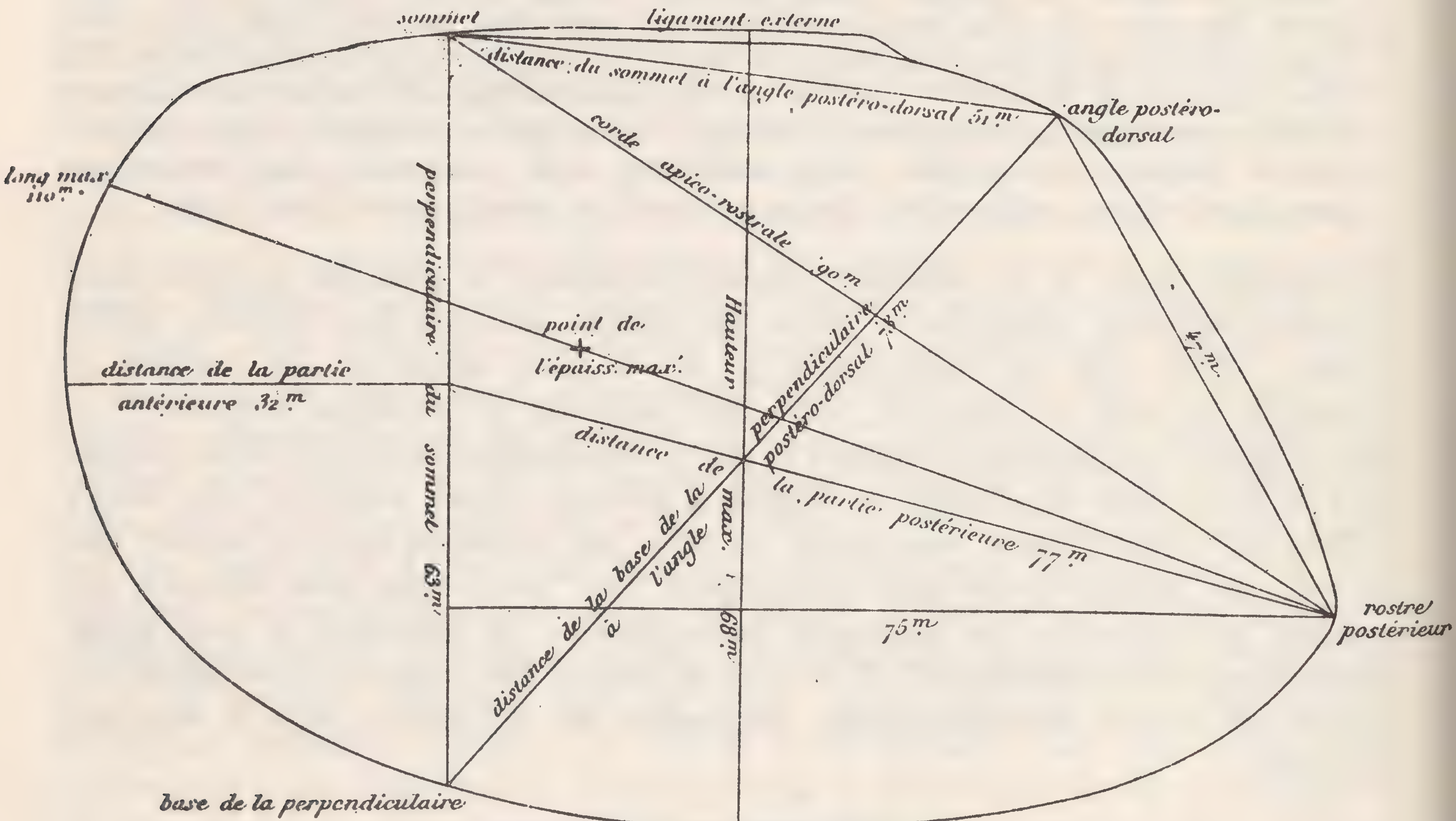
sommet
ligament externe
distance du sommet à l'angle postéro-dorsal 51m.
angle postéro-dorsal
corde apico-rostrale 90m
long max. 110m.
perpendiculaire du sommet 63m.
point de l'épaiss. max.
distance de la partie antérieure 32m
Hauteur max. 68m.
perpendiculaire postéro-dorsal 73m.
47m.
distance de la partie postérieure 77m.
distance de la base de la perpendiculaire à l'angle
75m
rostre postérieur
base de la perpendiculaire

Fig. 1. Bourguignat's method of bivalve mensuration; from the illustrative plate published in his *Matériaux pour servir à l'histoire des mollusques acéphales du système européen* (1880–81). The measurements so obtained were used by him and his disciples instead of illustrations.

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[34] In 1879 Etienne-Alexandre-Arnould Locard (1841–1904) had written: "Certains naturalistes ont, depuis quelques temps, tellement multiplié ces espèces que leur limite bien souvent est devenue fort difficile à apprécier. Pour d'autres, l'espèce même n'existe plus; ce ne sont que des formes passant des unes aux autres, avec des limites plus ou moins bien définies . . . Sans être exclusif ni pousser la chose aussi loin, nous devons reconnaître que l'étude comparée des formes quaternaires fossiles, avec celles qui vivent actuellement, nous a montré bien souvent des formes intermédiaires ou de passage entre les types plus anciens et les types modernes" (Locard 1879: 153–4). Nothing could be more in the spirit of the ancienne école than that. But shortly afterwards Bourguignat described a new species, *Anodonta locardi*, "que je dédie à M. Arnould Locard, de Lyon, auteur d'un grand nombre d'ouvrages scientifiques très estimés" (Bourguignat, 1880–81: 126). Perhaps this was enough to convert Locard. Almost immediately he embraced the Bourguignatian creed with enthusiasm.

[35] Bourguignat (1880–81) invented a "nouvelle méthode de mensuration" of freshwater bivalves. By measuring the distance in millimeters between certain specified points on a shell (See Fig. 1.) a series of measurements could be obtained which, in turn, could be translated into a drawing representing the shell's outline; the measurements did duty for illustrations and were the principal criteria for identifi-

Unio (Locard, 1889) and *Pseudanodonta* and *Anodonta* (Locard, 1890), each bursting with mensurated novelties, shows what he could do with the unionids of his own country; the consequences of applying this system to unionids of the world would be beyond comprehension. His revision of the European species of *Dreissena* (Locard, 1893) could not fail to result in a plethora of new "species"; nearly all of the novelties are immediately recognisable as forms of *Dreissena polymorpha* (Pallas). It was the same with his revision of the European species of *Bithynia* (Locard, 1894); of the dozens of species he recognised most are forms of the common *Bithynia tentaculata* (L.). He soon found himself the recipient of criticism formerly directed towards Bourguignat; the nouvelle école was now personified in him.

"Epilogue"

For his last paper Locard joined forces with Louis Germain (1878–1942), a much younger man (Locard and Germain, 1903). Ironically, Germain's reputation today rests largely on his pioneer attempts to bring order into the chaos which had been the nouvelle école's legacy to French malacology.[36] Germain was not the first Frenchman to try to undo the damage caused by the activities of the nouvelle école. Coutagne, a founder-member, left the fold and published a long essay on polymorphism among land snails which demonstrated the futility of "le Bourguignatisme" (Coutagne, 1894–95). This work indicates that Coutagne was a man of keen intellect and scientific probity. That he could once have lent his support to a school which he later helped to overthrow suggests that the school, or perhaps Bourguignat, had a magnetic appeal. A. Granger (1903) made an early and unsuccessful attempt to bring order into the enormously distended genus *Helix* (sensu lato). In a much larger work Germain (1928) tackled the same problem more satisfactorily; and his monographic account of the non-marine molluscs of France (Germain, 1930–31) is still the only intelligible treatment of the entire French fauna since the publication of Moquin-Tandon's *Histoire*.

The re-evaluation of Bourguignat's extra-European species has not fared so well. Paul Pallary (1869–1942) tried to clear up the confusion caused by Bourguignat's treatment of the molluscan fauna of Algeria and elsewhere in North Africa. Unfortunately, while he castigated Bourguignat and his disciples, he went a long way towards proving that he was no better: "Il ne fait guère

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cation. It must have occurred to Bourguignat that no two unionids could produce *exactly* the same series of measurements. Locard went one better when he said that, not only was a figure of a new species often unnecessary, in some cases it was possibly useless, or even detrimental to the correct "interprétation spécifique" of the species (Locard, 1884: 41).

[36] In 1903 he listed 188 unionid "species" from the environs of Angers and the department of Maine-et-Loire, and said that they represented, perhaps, only half of the species living there (Germain, 1903: 25); and in his early papers he cannot speak too highly of Locard. One who knew him has written: "Au début de sa carrière, Louis Germain subit nettement l'influence de Locard avec quil il était lié. Mais il comprit vite les inconvénients de sa tendance, et par la suite il changea considérablement sa notion de l'espèce" (Fischer-Piette, 1947).

de doute en effet que l'auteur ait fractionné les espèces beaucoup plus qu'il n'était nécessaire. . . . Un gros travail de révision s'imposera donc pour l'ensemble des espèces terrestres cataloguées par Pallary" (Fischer and Fischer-Piette, 1946). Of the more recent studies in which the Bourguignatian taxa have been re-evaluated that of Leloup (1953), on the molluscs of Lake Tanganyika, is the most noteworthy. Several studies of this scope and quality will be required to minimize the harmful effects of "le fanatisme du nobis".

Some specialists would like to see Bourguignat's new taxa officially invalidated. Even if such a course were practicable would it be desirable? Many Bourguignatian taxa are now entrenched in scientific literature and their extinction would make an already difficult situation worse; and surely the taxa of Locard, Servain and other nouvelle école members would have to be expunged too, with similar results. Even those of some non-Bourguignatians may have to be rejected. Species-mongering does not warrant such a severe penalty: few systematists have been unwilling to describe so-called new species (despite their protestations to the contrary). No, Bourguignat's "crime" was his inability to comprehend, or his reluctance to accept, the concept of a species as a biological entity. Species for him were abstractions; but does that matter? Should one reject them because one rejects his creed? Perhaps the only practicable and reasonable course is to evaluate them as we evaluate those of any other worker. Type specimens of most of his taxa are still available.[37] We need accept only those which satisfy the requirements of modern systematics. We may reject those which do not, providing we give sound reasons for doing so.

Bourguignat did not present his work in a slipshod manner. His descriptions are detailed and meticulous (characteristics rare among species-mongers at any time); and his illustrations, when given (which was more often than his detractors cared to admit), are extremely well drawn.[38] Seldom did he describe unlocalised material (this cannot be said of many of his more-respected contemporaries); and he was also the first to study in detail the molluscan faunas of many previously unworked areas.[39]

No-one can pretend that this is a happy episode in the history of malacology. In particular its effect on the science in France was disastrous, and even now few Frenchmen can be induced to take up the study of their native non-marine molluscs. It is unlikely that Bourguignat has a single willing apologist now. Many will notice a *double entendre* in the final words spoken over his coffin by a sorrowful member of the local brass band : "je vous adresse, cher M. Bourguignat, un eternel adieu" (Anon, 1892).

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[37] The Bourguignat collection, comprising about 13,000 lots representing about 4,300 taxa, is in the Muséum d'Histoire Naturelle, Geneva, and type material of many others described by him is in the Laboratoire de Malacologie, Muséum National d'Histoire Naturelle, Paris. Material described by Locard, Servain and other members of the nouvelle école is also in these and other public institutions.

[38] Unfortunately they are not always accurate. "On peut lui reprocher dans la figuration des espèces, d'avoir exagéré à dessin l'importance des caractères qui'l énonçait dans ses diagnoses" (Ancey, 1906: 237). Some of his illustrations do more than exaggerate minor shell features. In 1868, for instance, be described and illustrated several new fossil forms from Doui Hasseni in Algeria (Bourguignat, 1868b). Both the illustrations and descriptions are of complete, well preserved shells: the original specimens in his collection are all *internal moulds* (*fide* Pallary, 1901: 20).

[39] "Le grand mérite de Bourguignat a été d'approfondir la faune paléarctique, bien peu étudiée avant lui, et de contribuer une large part à la connaissance des Mollusques de l'Afrique tropicale" (Ancey, 1906: 237).

APPENDIX

Bourguignat's species concept

At the outset Bourguignat accepted the Cuvierian view of species (i.e. he believed they were immutable and displayed constant characters). Then he discovered Lamarck's transformist species-concept; he was impressed with the idea than an animal's morphology could be modified to a greater or lesser extent by time and environment. Many of the shells he studied, particularly those from North Africa, were so variable that he had had great difficulty in finding any constant characters. Finally he stopped looking for them and began describing "new species" on the basis of any observable characters regardless of their biological significance.

Bourguignat, like most Frenchmen at that time, may not have taken much notice of *On the origin of species* initially, but he certainly knew its contents eventually.[40] In his published letter to Kobelt he outlined the species concept of the nouvelle école which he equated with that of G. Saint-Hilaire, Lamarck and others, "celle qui ne croit pas à l'invariabilité de l'espèce, celle qui nie la fixité des caractères, et qui n'admet l'espèce, *ou ce qu'on est censé appeler espèce*, que *comme* RELATIVE *sous la double influence du temps et des milieux*. . . . La nouvelle école . . . qu'il ne faut pas confondre avec la *Darwinienne*, qui a outré ses principes et faussé ses conséquences, *ne reconnaît*, lorsqu'il s'agit d'une diagnose, NI ESPÈCE, NI RACE, elle specifie et elle caractérise TOUTES LES FORMES *que la nature a suffisamment distinguées*". . . (Bourguignat, 1882 : 36–7). Any form with less than three constant characters was a variety; any form with three or more was a species and merited a name. In other words a species did not exist outside of the imagination and so it was best to make an abstraction of it.

Bourguignat and Locard were afflicted by "le fanatisme du nobis"; but they also lived when there was little agreement over the species problem and workers had to try to sort it out to their own satisfaction. The writings of F. P. Marrat (1820–1904), the British malacologist who made a special study of *Nassarius* in the last quarter of the nineteenth century, show how difficult it was then for a man to comprehend the endless variations exhibited by shells of different but allied species. He began by describing many supposed new species and some years later concluded that the genus *Nassarius* contained a single immensely variable one; he had good reason to say that "everything connected with species making is arbitrary and entirely at the will or caprice of the author" (Marrat, 1879). The publication of *On the origin of species* could be said to have given the go-ahead to species-mongers who would have been quick to see that Darwin allowed them to decide for themselves what constituted the boundary between one species and another. As Lyell put it, in a letter to Hooker in 1856 : "So long as they feared that a species might turn out to be a separate and independent creation they might feel checked; but once abandon this article of faith, and every man becomes his own infallible Pope" (Himmelfarb, 1959 : 169). The activities of Bourguignat and his satellites amply justified this view.

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[40] Bourguignat's holograph "Catalogue des livres scientifiques de ma bibliothèque" (in the Muséum d'Histoire Naturelle, Geneva) lists the second French edition of the book, translated by Clémence Royer (Darwin, 1866). This was not the best version he could have owned; the translator's prefatory remarks and long textual footnotes often represent her personal views and do not help the reader's understanding of Darwin's text.

ACKNOWLEDGMENTS

Apart from reading the manuscript, providing translations from German and giving constant encouragement, Mr. J. G. J. Kuiper of Paris spent many hours extracting relevant passages for my use from the Baudon correspondence now in his possession. I regret that only a few of these extracts could be utilized. Similarly, Dr. E. Binder of the Muséum d'Histoire Naturelle, Geneva, took much interest in this paper, sent photocopies of relevant documents, and devoted much time to answering my many questions. To both of these gentlemen I express my warmest thanks.

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——, 1852c. Description d'une espèce nouvelle du genre *Pisidium. J. Conchyliol.* **3**: 174–6, pl. 8, figs. 8a–e.

——, 1853a. Notice sur le genre *Ancylus*, suivie d'un catalogue synonymique des espèces de ce genre. *J. Conchyliol.* **4**: 55–66, 168–9, 169–99, pl. 6, figs. 9–12.

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PETIT DE LA SAUSSAYE, S. 1853a. Observation [appended to a paper by Bourguignat on *Ancylus*]. *J. Conchyliol.* **4**: 200–203.

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J. Conch. *27*: 87–95 (1969)

LIST OF J.-R. BOURGUIGNAT'S PUBLICATIONS ON MOLLUSCS

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(*Read before the Society*, 15 *November* 1969)

This list has been compiled as a by-product of a paper on J.-R. Bourguignat (1829–92), the French malacologist, and his disciples ("Le fanatisme du nobis": a study of J.-R. Bourguignat and the "nouvelle école". *J. Conch.* **27**: 65–86, 1970).

Bourguignat wrote a great deal on molluscs and often contributed items to the writings of his friends. It is difficult to establish precisely the extent of some of those contributions, but an attempt has been made here to include all items *clearly attributable* to him. A number of items listed in his *Oeuvres scientifiques* (1891) are not *clearly attributable* to him and have been excluded.

Many items were published privately and in limited editions of 100 or less; consequently they are scarce in libraries and few copies exist with the original printed wrappers preserved (on which important information, such as date of publication, is often found). The collection of Bourguignatiana accumulated by the late J. R. le B. Tomlin, now in the National Museum of Wales, is one of the most complete in existence and has provided most of the data on which this list is based.

The articles comprising the *Aménités malacologiques* nearly all appeared previously at various times in the *Revue et Magasin de Zoologie*; it has not been thought necessary to give more than the published serial number of each (in roman capitals), but the date, volume number, page numbers, and plate and figure numbers of the relevant issue of *Revue Mag. Zool.* are given too. Some of the articles comprising the *Spicilèges malacologiques* were published previously in the same journal, and full references are given for each. Some of the twelve "décades" comprising the *Mollusques nouveaux, litigieux ou peu connus* also appeared previously in *Revue Mag. Zool.*; full references are given for each of these (none of which carries a title). In all instances references are given to what is believed to be the earliest form of publication. Few items have not been seen—each unseen item is indicated by an *—and few dates have not been ascertained satisfactorily (although only the *year* of publication is recorded). Excluded are references to some papers published in Spanish in *Cronica Cientifica*; apparently these are all abridged versions of papers published elsewhere.

1852a. *Testacea novissima quae Cl. de Saulcy in itinere per Orientem annis 1850 et 1851, collegit*. pp. 31. Lutetiae.

1852b. Description d'une nouvelle espèce de *Pisidium*. *J. Conchyliol.* **3** : 47–51, pl. 1, figs. 6–10.

1852c. Description d'une espèce nouvelle du genre *Pisidium*. *J. Conchyliol.* **3** : 174–6, pl. 8, figs. 8a–e.

1853a. Notice sur le genre *Ancylus*, suivie d'un catalogue synonymique des espèces de ce genre. *J. Conchyliol.* **4** : 55–66, 168–9, 169–99, pl. 6, figs. 9–12.

1853b. Monographie de l'*Ancylus Janii* (*Ancylus capuloides*, Porro). *Revue Mag. Zool.* (2) **5** : 203–14.

1853c. Description de quelques coquilles provenant de Syrie. *J. Conchyliol.* **4** : 69–74, pl. 3, figs. 5, 6, 8, 9, 10.

1853d. [Letter to S. Petit de la Saussaye]. *J. Conchyliol.* **4** : 450–1.

1853e. *Catalogue raisonné des mollusques terrestres et fluviatiles recueillis par M. F. de Saulcy pendant son voyage en Orient.* pp. xxvi, 96, 4 pls. Paris.

1853–60. *Aménités malacologiques.* 2 vols. **1** (1853–6), pp. viii + 255, 21 pls.; **2** (1856–60), pp. vii + 216, 24 pls. Paris. The two volumes comprise 85 numbered articles which appeared previously in *Revue Mag. Zool.* (2) **5–12** (the text and illustrations to four articles, and four additional plates, were published only in the book). The number of each article is given in roman capitals. *Revue Mag. Zool.* (2) **5** (1853) : 340–3 (I); 343–5 (II); 346–50 (III); 350–1 (IV); 351 (V); 352–4 (VI); **6** (1854) : 14–15, pl. 1, figs. 9–11 (VII); 15–16, pl. 1, figs. 12–14 (VIII); 75–83 (IX); 84–5 (X); 85 (XI); 85–105 (XII); 105–7 (XIII); 658–9, pl. 13, figs. 5–9 (XIV); 659–60, pl. 13, figs. 10–15 (XV); 660–1, pl. 14, figs. 1–6 (XVI); 661–3, pl. 14, figs. 7–12 (XVII); 663–4, pl. 14, figs. 13–17 (XVIII); 664–70, 1 table (XIX); 671–6 (XX); **7** (1855) : 23–6 (XXI); 26–9 (XXII); 29–31, pls. 1–2 (XXIII); 31–4, pl. 7, figs. 1–9 (XXIV); 317–30, pl. 7, figs. 14–19 (XXV); 330–1, pl. 7, figs. 10–12 (XXVI); 332–3, pl. 8, figs. 1–4 (XXVII); 333–4, pl. 8, figs. 5–7 (XXVIII); 556–74, pl. 15, figs. 1–9, pl. 16, figs. 1–12 (XXIX); **8** (1856) : 7–14, pl. 1, figs. 6–11 (XXX); 14, pl. 1, figs. 1–5 (XXXI); 15–16 (XXXII); 16–17, pl. 4, figs. 7–9 (XXXIII); 17–18, pl. 1, figs. 12–14 (XXXIV); 18, pl. 16 (of previous volume), figs. 13–15 (XXXV); 18–19, pl. 2, figs. 1–3 (XXXVI); 19–20, pl. 15 (of previous volume), figs. 10–11 (XXXVII); 20–1, pl. 15 (of previous volume), figs. 12–13 (XXXVIII); 21, pl. 15 (of previous volume), figs. 14–15 (XXXIX); 66–7, pl. 9, figs. 5–6 (XL); 67, pl. 9, figs. 2–4 (XLI); 68–79, pl. 2, figs. 4–8, pl. 3, figs. 1–4, pl. 8, figs. 1–5, pl. 9, fig. 1 (XLII); 79–80 (XLIII); 226–9, pl. 10, figs. 1–4, pl. 11 (XLIV); 229–41, pl. 15 (XLV); 241–7, pl. 9, figs. 7–9, pl. 14, figs. 25–7 (XLVI); 268, pl. 10, figs. 5–8 (XLVII); 268–77, pl. 14, figs. 1–24 (XLVIII); 327–40, pl. 13 (XLIX); 378–86, 424–35, pl. 12 (L) [articles I–L comprise the first volume of the two-volume re-issue]; 499–516, (*Aménit. malac.* **2** : pls. 8, 9 and 10, figs. 1–4) (LI); **9** (1857) : 3–8, pls. 9–10, (*Aménit. malac.* **2** : pl. 11, figs. 11–13) (LII); 8, pl. 8, figs. 1–3 (LIII); 9, pl. 8, figs. 10–12 (LIV); 9–10, pl. 8, figs. 7–9 (LV); 10, pl. 3, figs. 5–7 (LVI); 10–11, pl. 3, figs. 8–10 (LVII); 11–12, pl. 2, figs. 5–7 (LVIII); 12–13, pl. 4, figs. 5–9 (LIX); 13–16, pl. 1,

figs. 3–6 (LX); 16 (LXI); 16–17, pl. 4, figs. 1–4 (LXII); 17–21, pl. 1, figs. 1–2, pl. 2, figs. 1–4, pl. 3, figs. 1–4, pl. 8, figs. 4–6 (LXIII); 209–32, (*Aménit. malac.* **2**: pl. 10, figs. 5–16, pl. 11, figs. 1–10) (LXIV); 545–6, pl. 16, figs. 7–9 (LXV); 546–8, pl. 16, figs. 1–4 (LXVI); 548–65, pl. 17 (LXVII); **10** (1858): 527–45, pl. 18 (LXVIII, *part*); **11** (1859): 16–21 (LXVIII, *part*); 21–6, pl. 19 (of previous volume), figs. 3–4 (LXIX); 51–4, pl. 19 (of previous volume), figs. 1–2 (LXX); 54–5, pl. 19 (of previous volume), figs. 5–7 (LXXI); 55–9, pl. 19 (of previous volume), figs. 8–13 (LXXII); 512–9, pl. 19, pl. 20, figs. 1–3 (LXXIII); 519–22, pl. 20, figs. 4–9 (LXXIV); 522–3, pl. 20, figs. 14–16 (LXXV); 523–4, pl. 20, figs. 10–13 (LXXVI); (*Aménit. malac.* **2**: 139–40 (LXXVII); 140–4 (LXXVIII); 144–5, pl. 18, figs. 9–11 (LXXIX); 145–57, pl. 18, figs. 12–13 (LXXX)); 545–6 (LXXXI); **12** (1860): 65–71, figs. 1–6 (LXXXII); 71–5, 154–66, pls. 3–5, pl. 6, figs. 7–9, pls. 7–8 (LXXXIII); (*Aménit. malac.* **2**: 184–5, pl. 18, figs. 6–8 (LXXXIV); 186–8 (LXXXV)) [articles LI–LXXXV comprise the second volume of the two-volume re-issue].

1854a. Monographie des espèces françaises du genre *Sphoerium* [sic], suivie d'un catalogue synonymique des Sphéries constatées en France à l'état fossile. *Mém. Soc. Sci. phys. nat. Bordeaux* **1**: 155–208, pls. 1–4.

1854b. Descriptions d'Ancyles nouveaux de la collection de M. Cuming, précédée d'une courte notice sur le genre *Ancylus*, et d'un catalogue complet des espèces qui le composent. *Proc. zool. Soc. Lond. Pt.* **21** (for 1853): 76–93, pl. 25.

1860a. *Filum Ariadneum. Methodus Conchyliologicus denominationis sine quo chaos*. pp. 88. Paris.

1860b. *Malacologie terrestre de l'île du Château d'If près de Marseille*. pp. 36, 2 pls. Paris.

1860c. *Malacologie terrestre et fluviatile de la Bretagne*. pp. 178 + errata, p. 1, 2 pls.

1860–62. *Les Spicilèges malacologiques*. pp. vii + 287, 15 pls. (some coloured). Paris. Two of the articles in the book are original and the others were published previously in *Revue Mag. Zool.* Pages 42 (part), 43, 45–54, 139–263, and plates 1–5, 8, 11, 14 were published only in the book. Titles of articles given here are those of the original publication in each instance (in the book some of the *Revue Mag. Zool.* articles are sub-divided to form a greater number of smaller ones). Monographie du genre *Choanomphalus*. *Revue Mag. Zool.* (2) **12** (1860): 527–31, pl. 23, figs. 1–15; Catalogue des mollusques de la famille des Paludinées recueillis, jusqu'à ce jour, en Sibérie et sur le territoire de l'Amour. *Revue Mag. Zool.* (2) **12** (1860): 531–7, pl. 23, figs. 16–21, pl. 24 (*Spicil. malac.* pl. 8, figs. 1–4); Note sur divers Limaciens nouveaux ou peu connus. *Revue Mag. Zool.* (2) **13** (1861): 251–63, pl. 8, pl. 13, fig. 9 (*Spicil. malac.* pl. 14); Des Limaces algériennes. *Revue Mag. Zool.* (2) **13** (1861): 299–306, pl. 13, fig. 8 (*Spicil. malac.* pls. 1–2); (*Spicil. malac.* pp. 42 (part)–43); Monographie de la *Parmacella deshayesi* (*Spicil. malac.* 45–54, pls. 4–5); Notice sur les espèces vivantes et fossiles du genre *Testacella*. *Revue*

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1861. *Etude synonymique sur les mollusques des Alpes-Maritimes publiés par A. Risso, en 1826*. pp. 84, 1 portr., 1 pl. Paris.

1862. *Paléontologie des mollusques terrestres et fluviatiles de l'Algérie*. pp. 126, 6 pls. Paris.

1862–63. Malacologie du lac des Quatre-Cantons et de ses environs. *Revue Mag. Zool.* (2) **14** (1862): 430–44, 465–77, pls. 18–21; *ibid.* **15** (1863): 5–26.

1863a. Mollusques de San-Julia de Loria. *Revue Mag. Zool.* (2) **15**: 49–63, 150–60, pls. 13–14.

1863b. Monographie du nouveau genre français *Moitessieria*. *Revue Mag. Zool.* (2) **15**: 432–45, pls. 20–21.

1863–64. *Malacologie de l'Algérie ou l'histoire naturelle des animaux mollusques terrestres et fluviatiles recueillis jusqu'à ce jour dans nos possessions du nord de l'Afrique*. 2 vols. illust. fol. Paris. This was issued in six fascicules between May 1863 and December 1864; a complete collation is given by S. P. Dance, 1968, *J. Soc. Biblphy nat. Hist.* **5**: 19–22.

1863–70. *Mollusques nouveaux, litigieux ou peu connus*. 2 vols. **1** (première centurie) (1863–68), pp. 324, 45 pls.; **2** (onzième et douzième fascicules) (1870), pp. 55, 4 pls. (all published). Paris. The two volumes comprise descriptions and illustrations of 120 species grouped in 12 sets, ten species to a set (or décade). Some of the text and several plates were published in *Revue Mag. Zool.* but most of the book is original and is not published elsewhere. None of the décades carries a separate title. Décade 1: *Revue Mag. Zool.* (2) **15** (1863): 100–111, pls. 5–8; Décade 2: *Revue Mag. Zool.* (2) **15** (1863): 179–87, 252–61, pls. 18–19, *Moll. nouv.* **1**: pl. 7, figs. 1–8; Décade 3: *Moll. nouv.* **1**: 51–82 (1863), pls. 8–10; Décade 4: *Revue Mag. Zool.* (2) **16** (1864): 161–79, 193–212, pls. 11–18; Décade 5: *Revue Mag. Zool.* (2) **17** (1865): 337–47, pls. 16–23; *Revue Mag. Zool.* (2) **18** (1866): 6–23, pl. 19 (of previous volume), figs. 1–3, pl. 20 (of previous volume); Décade 6: *Moll. nouv.* **1**: 171–98 (1866), pls. 29–31; Décade 7: *Moll. nouv.* **1**: 199–221 (1866), pls. 32–34; Décade 8: *Moll. nouv.* **1**: 223–57 (1867), pls. 35–38; Décade 9: *Moll. nouv.* **1**: 259–94 (1868), pls. 39–41; Décade 10: *Moll. nouv.* **1**: 295–318 (1868), pls. 42–45; Décade 11: *Revue Mag. Zool.* (2) **22** (1870): 14–30, pl. 14, figs. 1–4, pl. 15, figs. 7–16, pl. 16, figs. 1–6, 10–12, pl. 17, figs. 1–3, 9–16; Décade 12: *Revue Mag. Zool.* (2) **22** (1870): 87–97, 166–71,

pl. 14, figs. 5–10, pl. 15, figs. 1–6, pl. 16, figs. 7–28, pl. 17, figs. 4–8, 17–21. The second volume of *Moll. nouv.* comprises only the last two décades and is usually, if not always, bound with the first volume.

1864a. *Malacologie d'Aix-les-Bains.* pp. 86, 3 pls. Paris.

1864b. *Malacologie de la Grande Chartreuse.* pp. 103, 9 unnumbered pls. (of scenic views) + 8 pls. (+ a duplicate of each one in colour). Paris.

1864c. Mollusques terrestres et fluviatiles recueillis par M. Henri Duveyrier dans le Sahara. (*in* : H. Duveyrier. *Exploration du Sahara. Les Touareg du Nord.*), pp. 30 (original pagination not given on the reprint, pls. 26–28. The *complete work* not seen by the writer.

1865. *Monographie du nouveau genre français Paladilhia.* pp. 21, 1 pl. Paris.

1866. Recherches sur la distribution géographique des mollusques terrestres et fluviatiles en Algérie et dans les régions circonvoisines. *Annls. Sci. nat.* (*Zool.*) (5) **5** : 313–54, pls. 10–11.

1867. *Lettres malacologiques. Ma première à M. Gassies.* pp. 19. Paris.

1868a. *Histoire malacologique de la Régence de Tunis.* (*Souvenirs d'une exploration scientifique dans le nord de l'Afrique.* Pt. III.) pp. 36, 1 pl., 1 map.

*1868b. *Histoire des monuments mégalithiques de Roknia, près d'Hammam Meskhoutin, en Algérie.* Paris. pp. ? Said to include a study of the shells found as well as an interpretation of climate and chronology using them.

1868c. *Etudes géologique et paléontologique des Hauts Plateaux de l'Atlas entre Boghar et Tiharet.* pp. 35, 3 pls., text illust. Paris.

1868d. *Note complémentaire sur diverses espèces de mollusques et de mammifères découvertes dans une caverne près de Vence.* pp. 12. Paris.

1868e. [Letter to P.-A. Moitessier concerning ideas and experiments on causes of sinistrorsity in non-marine snails] (*in*: P.-A. Moitessier, 1868, *Histoire malacologique du Département de l'Hérault.* Montpellier & Paris). pp. 84–91.

1868f. De la stratigraphie malacologique des espèces du Département de l'Hérault (*in*: P.-A. Moitessier, 1868, *Histoire malacologique du Département de l'Hérault.* Montpellier & Paris). pp. 95–111.

*1869. *Lettres malacologiques 2e.*

1870a. Catalogue des mollusques terrestres et fluviatiles des environs de Paris à l'époque quaternaire (*in* : M. F. E. Belgrand, *La Seine—I. Le Bassin Parisien aux âges antéhistoriques*), pp. 32, 3 pls. The *complete work* not seen by the writer.

1870b. Aperçu sur la faune malacologique du Bas Danube. *Annls. Malacol.* **1** : 36–76, pls. 3–4.

*1870c. Mollusques découvert dans une grotte près de Bagnères-de-Bigorre. (*in* : E. Frossard. *Note sure une grotte renfermant des restes humains.*) pp. ? Bagnères-de-Bigorre.

*1870d. Mollusques recueillis dans les marnes bleues des berges de la Saône. (*in* : H. de Ferry. *Mâconnais préhistorique.*) pp. ? Mâcon.

1870e. Description d'espèces nouvelles de mollusques terrestres du département des Alpes-Maritimes. *Mém. Soc. Sci. nat. hist. Cannes* **1** : 45–59.

1874a. Catalogue des mollusques recueillis dans le tumulus du plan de Nôve. *Mém. Soc. Sci. nat. hist. Cannes* **3** : 274–89.

1874b. Note sure quelques coquilles fossiles terrestres et fluviatiles trouvées dans les dépôts de phosphorites du département de Tarn-et-Garonne. *Bull. Soc. Sci. phys. nat. Toulouse* **1** : 440–6, 1 pl.

1875. Description d'un genre nouveaux de la craie chloritée de Vence. *Mém. Soc. Sci. nat. hist. Cannes* **5** : 324–6.

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1877a. *Aperçu sur les espèces françaises du genre Succinea.* pp. 32. Paris.

1877b. Descriptions de deux nouveaux genres algériens, suivies d'une classification des familles et des genres de mollusques terrestres et fluviatiles du système européen. *Bull. Soc. Sci. phys. nat. Toulouse* **3** : 49–101.

1877c. Hélices françaises du groupe de la Telonensis. *Revue Mag. Zool.* (3) **5** : 232–49.

1879a. *Description de divers espèces terrestres et fluviatiles et de différents genres de mollusques de l'Egypte, de l'Abyssinie, de Zanzibar, du Sénégal et du Centre de l'Afrique.* pp. 54. Paris. Published June 1879 at latest, according to B. Verdcourt, 1965, *J. Conch.* **25** : 336.

1879b. Monografia del nuovo genere Siciliano *Allerya. Atti Acad. Sci. Lett. Palermo* (*N. Ser.*) **6** : 1–7, 5 text figs.

1880a. *Recensement des Vivipara du système européen.* p. 52. Paris. The Tomlin copy has a printed "Rectification" pasted onto p. 52. It proposes a new name—*Vivipara nevilli*—in place of *Vivipara forbesi* which occurs on p. 43.

1880b. *Description du nouveau genre Gallandia.* pp. 8. Saint-Germain.

1880c. *Monographie du genre Emmericia.* pp. 87. Angers.

1880d. *Etude sur les fossiles tertiaires et Quaternaires de la Vallée de la Cettina en Dalmatie.* pp. 55. Saint-Germain.

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1881d. [Critical study of the European species of the *Helix strigella* group.] (*in*: G. Servain, 1881. *Histoire malacologique du Lac Balaton en Hongrie.*) pp. 24–30. Paris.

1881e. [Monograph of the genus *Segmentina.*] (*in*: G. Servain, 1881. *Histoire malacologique du Lac Balaton en Hongrie.*) pp. 86–90. Paris.

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1882a. *Bythiospeum, ou description d'un nouveau genre de mollusques aveugles.* pp. 16. Poissy.

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1883g. [Critical and descriptive list of species of the *Helix lactea* group.] (*in*: J. Péchaud, 1883. *Excursions malacologiques etc.*) pp. 54–64.

1883h. [Critical study of the bidentate helices of North Africa.] (*in*: J. Péchaud, 1883. *Excursions malacologiques etc.*) pp. 85–94.

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1884a. Description du nouveau genre *Sesteria. Bull. Soc. malac. Fr.* **1** : 135–8, pl. 3, figs. 1–5.

1884b. Histoire des mélaniens du système européen. *Annls Malacol.* **2** : 1–168.

1884c. Nouvelle Vivipare française et liste des espèces constatées en France dans le genre *Vivipara. Bull. Soc. malac. Fr.* **1** : 183–8, pl. 3, figs. 6–10.

1884d. Hélice nouvelle des montagnes de l'Ariège. *Bull. Soc. malac. Fr.* **1** : 357–8.

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1886b. Des Tiphobies du lac Tanganika. *Bull. Soc. malac. Fr.* **3** : 141–50, pl. 6.

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1887b. Mollusques nouveaux de la région du Nyanza-Oukéréwé (Victoria Nyanza). *Bull. Soc. malac. Fr.* **4** : 267–72.

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1888a. Histoires des Hélices campyléennes du groupe des dinariques (olim *Helix pouzolzi*). *Bull. Soc. malac. Fr.* **5** : 203–45, pls. 2–4.

1888b. *Iconographie malacologique des animaux mollusques fluviatiles du Lac Tanganika.* pp. 82, 35 pls. Corbeil.

1889a. *Mollusques de l'Afrique Equatoriale de Moguedouchou à Bagamoyo et de Bagamoyo au Tanganika.* pp. 229, 8 pls. Paris.

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1890a. *Chambardia.* Nouveau genre égyptien de la famille des Iridinidées. (pp.

304–15, pl. 7 *in*: G. Servain, 1890. Des acéphales lamellibranches fluviatiles du système européen.) *Bull. Soc. malac. Fr.* **7**: 281–323, pls. 5–7.

1890b. Des formes européennes trocho-hyalinoïdes classées jusqu'à présent sous le nom générique de *Conulus*. *Bull. Soc. malac. Fr.* **7**: 325–8, pl. 8.

1890c. Histoire malacologique du Lac Tanganika (Afrique Equatoriale). *Annls Sci. nat.* (*Zool.*) **10**: 1–267, pls. 1–17.

1891. *Oeuvres scientifiques de M. J.-R. Bourguignat . . . précédées d'une préface biographique par le Dr. Georges Servain . . .* pp. viii + 256. Paris. The "préface biographique" occupies pp. i–vii; the remaining pages, though not stated in the book, should be credited to Bourguignat himself as the original manuscript, in the Muséum d'Histoire Naturelle, Geneva, is entirely in his handwriting.

1925. Dates des livraisons de l'Histoire des mollusques de Férussac et Deshayes, vérifiées d'après le registre de l'éditeur Baillière, de Paris. *J. Conchyliol.* **69**: 15–18 This first printing of a Bourguignat manuscript is prefaced by an anonymous note.

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ADULA SIMPSONI (MARSHALL) IN SHETLAND

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(*Read before the Society*, 15 *November* 1969)

The bivalve *Adula simpsoni* (Marshall) is usually found living on old whale skulls, lying in the sutures and attached by a byssus. It has been recorded in this habitat from off Aberdeen, N.W. of Fair Isle, E of Orkney (Marshall, 1900) and S.W. of Ireland. It has also been taken living in a piece of pitchpine which had been bored by *Xylophaga* and *Teredo* and in the deserted holes of which lived the *Adula*.

On July 17th 1969 I picked up on the shore at West Sandwick, on the west coast of the island of Yell, Shetland, a small piece of bored driftwood (pitchpine) with the intention of examining it for *Teredo*. It was not until November that I had an opportunity of breaking up the driftwood and searching it carefully. It yielded a few small valves and a single pallet of *Psiloteredo megotara* (Hanley) and in addition a minute fresh but dead bivalve (length 2·5 mm.). This proved to be a specimen of *Adula*, unfortunately the only one present. Presumably the many vacant borings in the driftwood were as suitable for attachment by *Adula* as the sutures of a whale skull, and evidently the species is not confined to whales' skulls and should also be looked for in bored driftwood.

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THE DISTRIBUTION OF *DREISSENA POLYMORPHA* (PALLAS) IN BRITAIN

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During the early part of the nineteenth century, the geographical range of *Dreissena polymorpha* (Pallas) was dramatically extended. Previously confined to an area encompassing the Black and Caspian Seas, it suddenly appeared in Rotterdam in 1826, in Hamburg in 1830, and at Copenhagen in 1840. Haas (1929) gives perhaps the most comprehensive account of the spread of *Dreissena* across Europe. In Britain it was first noted in the Surrey Commercial Docks, London, in 1824 (Sowerby, 1825); at Wisbech, Cambridgeshire, probably in the 1820's (Berkeley, 1836); at Goole Docks, Yorkshire, in 1831–33 (Bell, 1843); near the eastern end of the Forth and Clyde Canal in 1833 (Scouler, 1833); and in the Union Canal near Edinburgh in 1834 (Berkeley, 1836). After 1835 records become numerous, and by 1850 the species had probably attained more or less its present distribution (Kew, 1893).

Some pre-nineteenth century fossil occurrences have been claimed (Kennard and Woodward, 1903; McMillan, 1958), but none is well substantiated. Shells have been found in the geologically modern lake-marl of Whittlesey Mere, Huntingdonshire (Kennard, 1940), and Bellars (1858: 27) claims that it was abundant there living even before its discovery in the London Docks in 1824. Since this lake (drained in 1851) was in direct communication with Wisbech via a branch of the canalized River Nene, this early occurrence is easily accounted for.

Dreissena first appeared in Britain at a time of greatly increased international trade. That it arrived attached by its byssus to the bottom of ships, as was at first suggested by Lyell (1837, **3** : 60), seems very unlikely, since experiments have shown that although *Dreissena* can live for a long time out of water, it cannot survive in seawater for more than two or three hours. More probably it travelled inside vessels, either in ballast, which would be discarded on arrival, or attached to merchandise; indeed, most contemporary writers (e.g. Gray, 1825) accepted that it probably came over with imported timber. After 1815 Baltic fir from Riga, Memel and Danzig began to enter the country in quantities sufficiently great to influence methods of architectural construction (Summerson, 1962 : 218). Gray (1840 : 302) says "I am now confirmed in the idea that this is the way in which they were introduced, as a friend has informed me that he has seen them sticking to the logs of Baltic timber before they were unloaded from the ship. In the dock they attach themselves to stones, *Uniones*, *Anodons*, and the walls of the docks, as well as the logs". Bell (1843) believed that *Dreissena* reached Goole Docks on timber in this way, "its tenacity of life being fully capable of sustaining it during the voyage, in the damp hold of a ship". And it is interesting to note that Lyell, in the later editions of his famous book (1840, **3** : 146), accepted this explanation as the likely one.

The earliest known places of establishment of *Dreissena* in Britain are shown on Figure 1. All are in the eastern part of the country, at or near sea ports trading in Baltic timber (London, Wisbech, Goole and Grangemouth). It is probably significant that *Dreissena* is able to survive and indeed flourish under somewhat brackish conditions, as would be found in docks at the heads of tidal estuaries, for once established, the animals were quickly able to expand from such foci into the hinterland of rivers and canals. The great importance as a means of internal communication at this time of the newly constructed network of inland waterways was a factor enabling *Dreissena* to establish itself firmly within the ramifications of the canal system.

The map (Figure 1) summarizes, on a basis of the 10-kilometre grid, all accessible information on the distribution of *Dreissena* in Britain. Modern (post-1950) data are derived from the Conchological Society's mapping scheme, and also from the results of a questionnaire recently sent by one of us (B.S.M.) to a large number of water authorities. A fairly thorough search has also been made through the older literature, and in collections (thanks are due to Mr. I. M. Evans, Mr. D. Heppell, Mrs. N. F. McMillan and Mr. J. F. Peake for kindly providing records of *Dreissena* from the collections at Leicester, Edinburgh, Liverpool and London respectively). The resulting pattern of dots clearly reflects the alignments of canals and slow navigable rivers in what Boycott termed the "canal basin"; for example, it is possible to pick out such waterways as the Grand Union Canal, the Oxford Canal, the Leeds and Liverpool Canal, the Great Ouse, the River Nene and the River Witham. The abundance of *Dreissena* in the larger dykes of the southern Fenland is also shown. But in some areas, notably in the west Midlands, the species appears to be becoming scarcer. In the Lancaster Canal it cannot be found alive in places where it was formerly abundant, a decline also remarked upon by Boycott and Oldham after searches in 1920 and 1937 (1938 : 40). The same may be true of the Leeds and Liverpool Canal, in spite of the frequency of old bleached valves in many places (A. Norris, personal communication). Again, no recent records are available from the urban areas of Birmingham and Manchester, although here the lack of reports may be due merely to the fact that these cities now draw most of their water from Wales or the Lake District and not from local sources; water authorities are therefore much less likely to meet with the species than formerly. *Dreissena* remains common enough in London waterworks where supplies are drawn from the River Thames or River Lea.

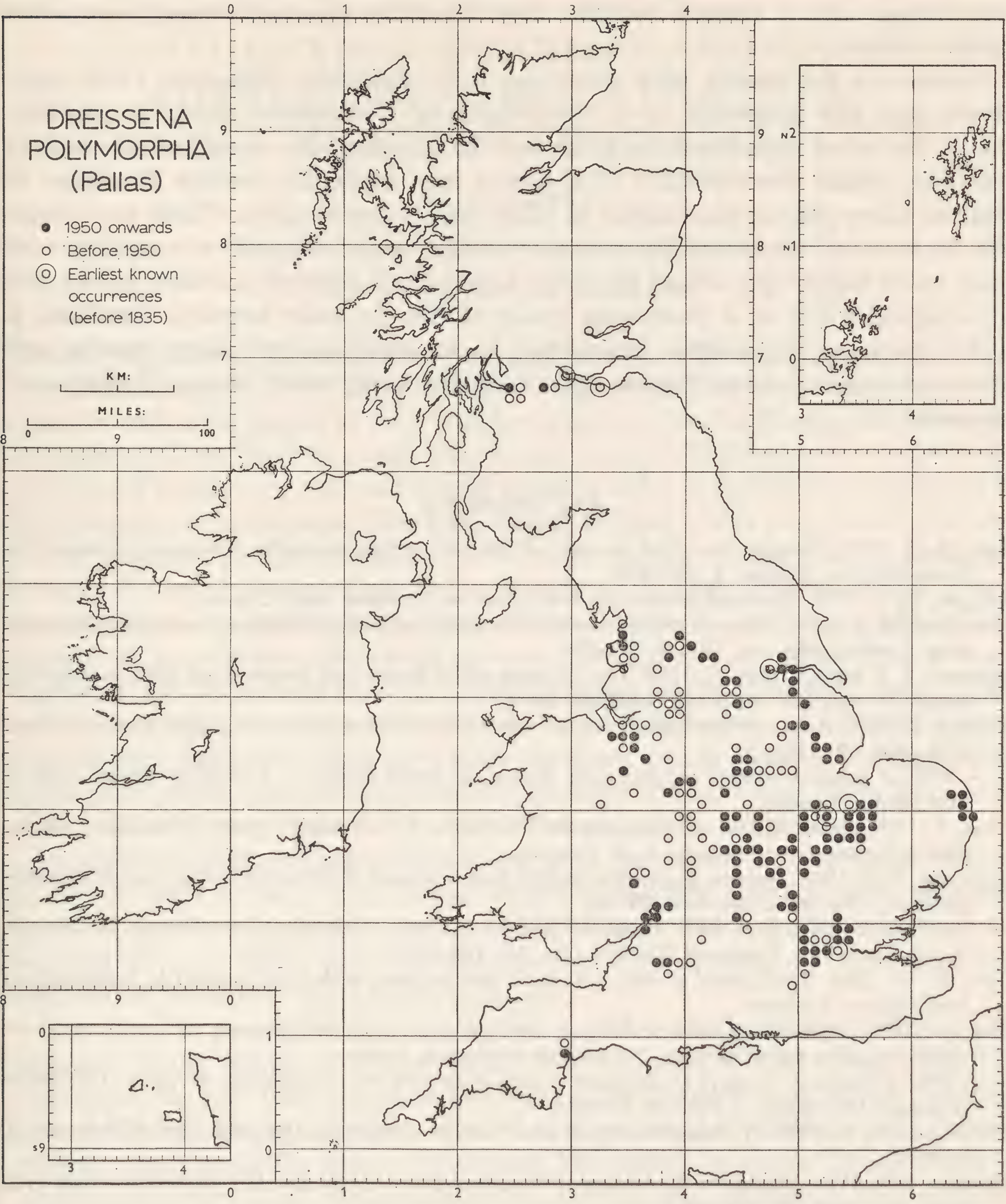

Fig. 1. British distribution of *Dreissena polymorpha*, based on the 10-kilometre grid. Recent finds of dead shells in bleached, 'chalky' condition are regarded as 'pre-1950'.

Although *Dreissena* is uniquely well suited to dispersal through continuous bodies of freshwater, its life history and anatomical peculiarities would seem to militate against passive dispersal overland. It is likely, therefore, that the geographically isolated occurrences in the Exeter Canal (it was detected near Exmouth as early as 1842 (Pratten, 1868)), in the Midland valley of Scotland,

and perhaps also in eastern Norfolk, must represent separate introductions from outside Britain.

Studies on the reason why *Dreissena* is so successful (Morton, 1970) have shown that the possession of a free-swimming trochophore larva is probably one of the most important single factors determining the rapid colonization of new sites, whilst the retention of a byssus into adult life enables *Dreissena* to colonize stony places, inaccessible to other freshwater bivalves. These two primitive features of the animal's anatomy enable it to compete successfully with other more highly specialized bivalves, which have evolved parasitic larvae and are adapted solely to a burrowing mode of life. In some respects, therefore, it is the retention of primitive characters, in an environment where greater and greater degrees of specialization have been the rule, which makes *Dreissena* so successful.

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POPULATION CHANGES SHOWN BY *COCHLICOPA LUBRICA* (MÜLLER) IN A GRASS SWARD HABITAT

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(*Read before the Society*, 19 *October* 1968)

Natural populations of animals are commonly found to fluctuate in their numbers even over relatively short periods. No animal community remains numerically static for any great length of time and for many species the density shows violent fluctuations. The Slippery Snail, *Cochlicopa lubrica* (Müller), was studied in a grass sward habitat for two and a half years in order to follow any variations in the numbers of individuals. The grass sward habitat forms part of an extensive area of ungrazed pasture landward of the main sand dune ridges on the Braunton Burrows National Nature Reserve, N. Devon (Nat. Grid Ref. SS 4030). It is a closed community in which the grass *Festuca rubra* L. and the sedge *Carex arenaria* L. are the dominant plant species. The grasses and sedges form a dense vegetative mat at ground level in which there are no areas of bare sand. These shallow rooting species, together with the abundant mosses within the habitat, result in the rapid absorption of surface moisture and so make the upper layers of the sand surface dry during periods of restricted rainfall. There is a small amount of sand accretion on the pasture but very little erosion.

In order to assess the population changes in the density of the snails an area of 20 × 20 metres was delimited and monthly random samples were collected. The samples were obtained by removing 25 × 25 cm. quadrat areas of all vegetation and soil to a depth of 5 cm. The samples were dried at 35°C., sieved and hand sorted to remove the living specimens.

Considerable monthly variations in the numbers of *Cochlicopa lubrica* were observed during the study period June 1964 to January 1967 (Figure 1). The population showed peak densities following both summer and winter breeding phases. Young individuals were collected throughout the year but were at their greatest numbers during May–August and November–January. The presence of juvenile specimens at all seasons indicates that the reproductive activity was not limited to a specific time but was pursued at least on a reduced scale by the population throughout the year. These observations are in agreement with those of Quick (1954) at Box Hill, Surrey, where both adult and juvenile specimens were noted at all seasons. Mapes and Krull (1952) noted that in an American dry pasture the snails oviposited at any month of the year, provided the temperature remained above freezing. These authors did not consider *Cochlicopa lubrica* to be a prolific egg layer. At Braunton Burrows reproductive activity was at a maximum during the summer and mid-winter periods. During these times the

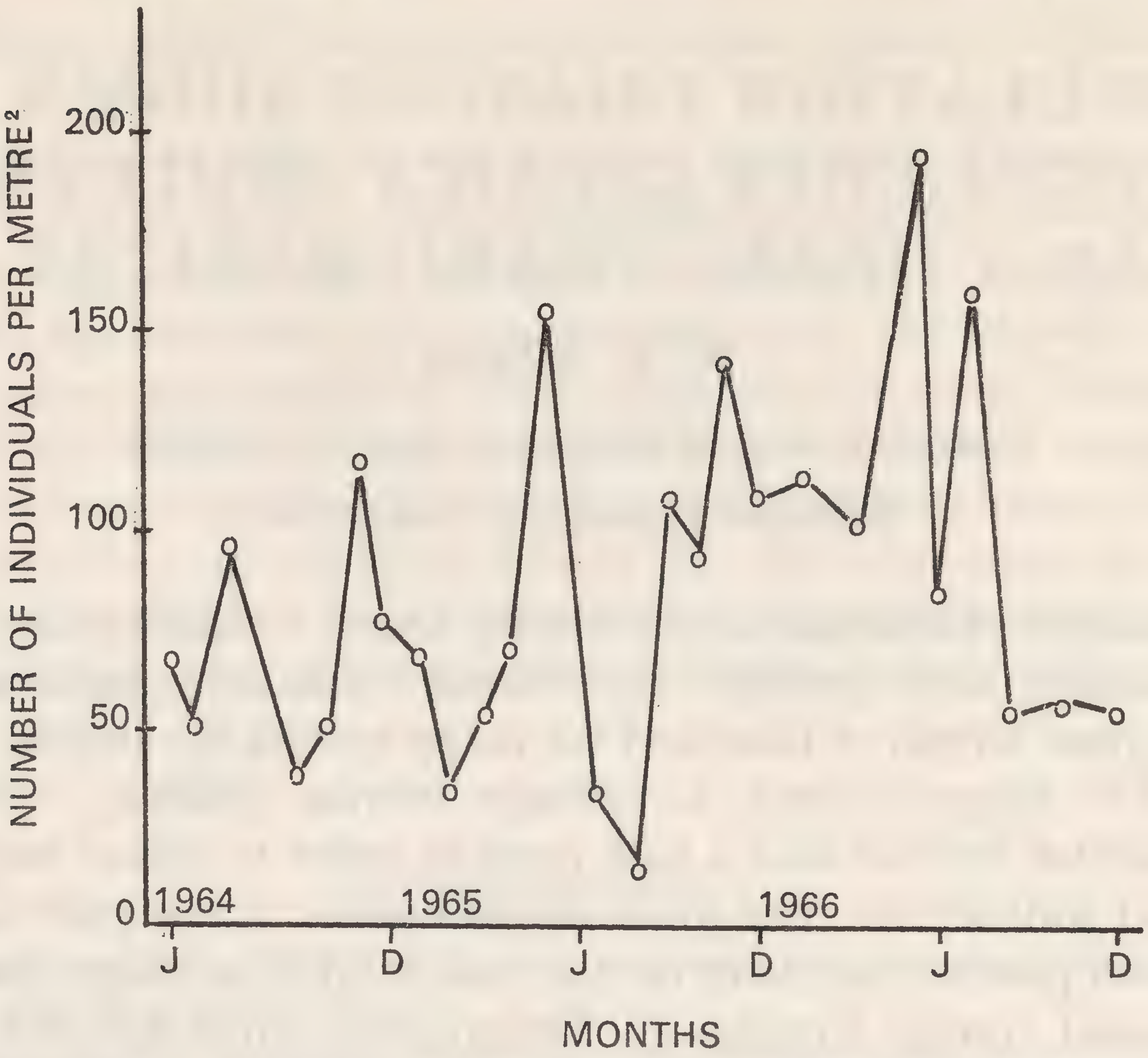

Fig. 1. *Cochlicopa lubrica.* Variations in the population density during the period 1964–66.

snail densities showed significant increases as the young hatched from the eggs. The mortality rate amongst the population following these peak densities in 1964 and 1965 was very high and led to a rapid decrease in snail numbers. The decline in the densities of *Cochlicopa lubrica* was not solely confined to the juveniles but was equally evident in the numbers of recently dead adults collected. The winter breeding of 1965–66 differed from this pattern in so far as the population was able to maintain, until the summer breeding phase, a greater overall density of snails than at any other time during the study period. The high densities resulting from the reproductive activity of young individuals in late 1965 were not followed by a marked decline in snail numbers either amongst the adults or juveniles.

Mapes and Krull (1951) are of the opinion that the requisite factors necessary for large populations of *Cochlicopa lubrica* are moist soil, almost constant shade and a large quantity of suitable vegetation. The grass sward at Braunton provides an essentially dry environment, where even after heavy rain the shallow rooting grasses and sedges rapidly absorb the surface moisture. The moisture content of the top 5 cms. of the sand surface taken at monthly intervals throughout the study period showed an average moisture content of 8·7% per gramme of oven dried soil. Weather is clearly an environmental component that affects the rate of numerical change directly in this species. The arid nature of the grass sward following the July–August and November–December 1964 spawnings was a major factor in restricting reproductive activity and in reducing the numbers of snails. In contrast the relative stability of the population numbers following the 1965–66 winter breeding was probably a consequence of the more prolonged period of rainfall and hence the greater topsoil moisture content recorded at this time. This wetter period favoured the survival of both adult and juvenile snails in the population in greater densities than in the preceding peak phases.

The two distinct peaks of abundance shown by *Cochlicopa lubrica* during a single year suggest that the onset of reproductive activity is only in part influenced by climatic conditions. An analysis of the rainfall data from the adjacent R.A.F. Station at Chivenor shows that the main breeding phase can occur in comparatively dry periods. For example, the 1964 summer spawning occurred when only 11·6 cms. of rain fell during the months June–August and when the sand surface showed a mean moisture content of only 3·7%. Whilst rainfall and the moisture balance within the habitat may in part determine the exact timing of the periods of maximum reproductive activity, the overall cycle of reproduction involving the summer and mid-winter breeding stages appears to be governed by factors other than those of climate. For a considerable part of the year, during which climatic conditions are apparently favourable to reproduction, most individuals of *Cochlicopa lubrica* do not reproduce and even those snails that do breed do so only at a low rate.

It is unlikely that any seasonal changes in the food supply could affect the mortality rate amongst the snails since there is a plentiful supply of litter and vegetation in the grass sward throughout the year. Mapes and Krull (1952) noted that *Cochlicopa lubrica* feeds upon both green and dead plant material under laboratory conditions but they had no evidence of green plants being eaten under natural conditions. The effects of predation, if any, by other animals is unknown and may in part explain the rapid decline in numbers following the peak density phases.

The only data available on the density of *Cochlicopa lubrica* in other U.K. sites is that recorded by Boyd (1960) in his studies on the grazed and ungrazed coastal grass habitats in Tiree, Argyll. He found densities equivalent to 22 snails/metre^2 on the stable stand dunes and 33 snails/metre^2 on an area of ungrazed grassland during November. These densities correspond to the lower levels recorded in the Braunton sward during the present studies. Mapes and Krull (1952) observed densities of between 111 and 577 snails/metre^2 in a North American dry grass pasture. Roscoe (1962) noted that in widely scattered localities in the United States of America aggregations of *Cochlicopa lubrica* occurred from late May and early June until late October. In one site in Oak Park, Illinois, specimens were collected at the rate of one hundred in a few minutes. These observations would suggest a high density for the snail, although the author notes that these were essentially aggregations in localised areas and they were not typical of the density in general. Pilsbry (1948) has suggested that these aggregations result from a reproductive response by the mature snails for the purpose of mating. Neither of these two authors, however, commented upon the age structure of the aggregated populations although it is implied that they were all sexually mature specimens. No evidence of aggregation amongst the Braunton population was noted during the present study.

ACKNOWLEDGMENTS

I would like to acknowledge the help of Mr. A. E. Ellis for the initial identification of the specimens from Braunton upon which further species determinations were carried out by the author. My thanks are also due to my colleagues of the Physiographic Section of the Nature Conservancy for their advice and aid during this study.

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J. Conch. 27: 105–109 (1970)

AGRIOLIMAX AGRESTIS (L.) IN THE MORAY FIRTH AREA OF SCOTLAND

Edwin Kellock

Duntuilm, Knock, Huntly, Aberdeenshire.

(*Read before the Society*, 19 *October* 1968).

In November 1966 at the request of Dr. M. P. Kerney, recorder for the mollusc-recording scheme of the Conchological Society, collections of unidentified molluscs were forwarded to him from various 10 km. squares in Banffshire. In one of these collections, taken from the valley of the Braco Burn in the parish of Grange, 6 km. E. 10° N. of Keith, Dr. Kerney recognised several slugs as *Agriolimax agrestis* (L.), the identification being confirmed by Mr. A. E. Ellis and recorded by him in a footnote to a recent paper (1967, 189) as being the first authenticated occurrence of this species on the Scottish mainland. As the collection was made over a 1 km. length of the valley from opposite Craiglethie to the bridge on the A95 road, it was suggested that the exact locality be ascertained, the type of habitat noted and that further search be made for this slug in the vicinity.

It proved too late to find the slug again in the same season, but, again on the advice of Mr. Ellis, the search was resumed in the autumn of 1967 with the results summarised in Table 1 below, the localities enumerated being indicated on the map, Fig. 1.

It will be noted that the majority of specimens were climbing on the flowering stems of Umbelliferae where they are particularly conspicuous, but that a fair proportion were found in other places, e.g. on grass and in the usual type of slug refuge. It may also be of interest to note that stations range in height from near sea level at Boyne Bay (locality 7 of Table) to 900′ O.D. in Clashindarroch Forest (locality 23).

Of the 23 stations enumerated in Table 1, Nos. 4, 5, 9, 11, 13, 14, 17, 18, 19, 21 and 23 were selected as representing the full range of habitat types and subjected to more detailed inspection, other molluscs found being identified and tabulated and the associated flora examined by an experienced botanist, Mr. D. Welch of Banchory, who reports as follows:

"The vegetation at all sites was mesophilous grassland. It ranged in type from wet to dry, and from grazed to uncut. Tall-growing grasses (*Arrhenatherum elatius*, *Dactylis glomerata*, *Deschampsia cespitosa* and *Holcus lanatus*) and herbs (*Anthriscus sylvestris*, *Cirsium arvense*, *Heracleum spondylium*, *Ranunculus repens*, *Rumex acetosa*, *Urtica dioica* and *Veronica chamaedrys*) were predominant, and at least one species of umbellifer was present at each site, the other species (over and above the *Anthriscus* and *Heracleum* already specified) being *Aegopodium podagraria*, *Angelica sylvestris*, *Conopodium majus* and

LOCALITY No.	DATE OF COLLECTION	LOCALITY	VICE-COUNTY	NATIONAL GRID REREFENCE 100km. sq. 38 (NJ) THROUGHOUT	HABITAT	OTHER MOLLUSCS PRESENT
1	Sept. 1967	Cornfield, 200m. east of Nethertown of Knock	94	546524	On oat stem.	
2	12/9/1967	Beside tributary of Braco Burn, 300m. east of Floors, Grange.	94	496527	On Umbelliferae.	
3	12/9/1967	Beside Braco Burn, west of Craiglethie, Grange.	94	498524	On Umbelliferae.	
4	12/9/1967	Beside Braco Burn, 200m. southwest of Craiglethie, Grange.	94	496523	On Umbelliferae.	52, 118, 128, 136, 149, 151.
5	14/9/1967	Between Knockdhu Distillery and Knock Burn.	94	548528	On Umbelliferae.	52, 117, 122a, 125.
6	14/9/1967	Rough meadow 300m. north of railway bridge, Knock.	94	545532	On Umbelliferae.	
7	19/9/1967	Valley of Boyne Burn, southwest of Boyne Bay.	94	616660	On Umbelliferae.	
8	26/9/1967	In overgrown garden of old croft near Whitely, Grange.	94	523568	Under piece of wood.	
9	26/9/1967	Bank of burn above bridge, 400m. north of Upper Broadrashes, Deskford.	94	514599	Under damp plant debris.	93, 128, 136, 151.
10	29/9/1967	Ditch, northeast of plantation, 400m. northeast of Inchford, Ordiquhill.	94	565575	On heavily shaded bank of ditch.	
11	29/9/1967	Outside northwest corner of same plantation (See No. 10 above).	94	562575	Under stone on rushy moorland.	117, 129, 149.
12	8/10/1967	High field of Thorax farm, Culvie.	94	582548	On pasture.	118, 149.
13	8/10/1967	Farm road on south side of Culvie Hill, Culvie.	94	579544	Drowned in road puddles.	91, 117, 136.
14	9/10/1967	Between track and ditch 400m. southeast of Milton $1\frac{1}{2}$km. W.N.W. of Huntly.	93	518403	Amoung cut weeds, mainly grass.	91, 120, 126, 132, 133, 136.
15	9/10/1967	400m. south of locality No. 14 and beside same track.	93	518399	On grass.	
16	9/10/1967	Roadside, north of Craighead Dam, 3km. west of Huntly.	93	495406	On Umbelliferae.	
17	9/10/1967	Roadside, between the ends of Drumdelgie and Broadland farm roads, 5km. west of Huntly.	93	486420	On Umbelliferae.	18, 55, 114, 120, 125, 128, 136, 149.

LOCALITY No.	DATE OF COLLECTION	LOCALITY	VICE-COUNTY	NATIONAL GRID REFERENCE 100km. sq. 38 (NJ) THROUGHOUT	HABITAT	OTHER MOLLUSCS PRESENT
18	9/10/1967	Roadside, north of Deveron bridge, Haugh of Glass.	93	424387	On Umbelliferae.	52, 91, 93, 125, 126, 132, 133, 136.
19	9/10/1967	Roadside, 200m. north of Playlands, Glass.	93	434381	On Umbelliferae.	120, 129, 132, 136, 149.
20	4/11/1967	Roadside near Dipple, Orton.	95	327576	On Umbelliferae.	
21	4/11/1967	Left bank of River Spey at Boat o' Brig, Orton.	95	318518	On Umbelliferae.	53, 91, 93, 122a, 136, 149.
22	18/11/1967	Roadside, A98, 3km. N.N.E. of New Byth.	93	834567	On ground below. plant cover.	
23	19/11/1967	Beside forest track, 400m. E.N.E. of Finglenny, 3km. W.S.W. of Clashindarroch Lodge, 9km. S. by W. of Huntly.	93	461308	On ground below plant cover.	117, 124, 125, 126, 132, 136.

Notes:—

1) The vice-counties referred to by numbers in the table are as follows:—

v.c. 93.	Aberdeen North.
v.c. 94.	Banff.
v.c. 95.	Moray.

2) Accompanying molluscs, designated in the table by the numbers allocated on the check cards issued by the Conchological Society in connection with the distribution mapping scheme, are as follows (identifications of snails by Dr. M. P. Kerney):—

18.	*Carychium tridentatum.*	117.	*Arion intermedius*	128.	*Oxychilus cellarius.*
52.	*Cochlicopa lubrica.*	118.	*Arion circumscriptus agg.*	129.	*Oxychilus alliarius.*
53.	*Cochlicopa lubricella.*	120.	*Arion subfuscus.*	132.	*Retinella pura.*
55.	*Columella edentula.*	122a.	*Arion ater agg.*	133.	*Retinella nitidula.*
91.	*Arianta arbustorum.*	124.	*Euconulus fulvus.*	136.	*Vitrina pellucida.*
93.	*Helix hortensis.*	125.	*Vitrea crystallina.*	149.	*Agriolimax reticulatus.*
114.	*Punctum pygmaeum.*	126.	*Vitrea contracta.*	151.	*Agriolimax laevis.*

Myrrhis odorata. The Knockdhu Distillery site (5) was wet, overlying fen peat and the Inchford site (11) was in a sown pasture having much *Alopecurus pratensis* and *Lolium perenne*. The Playlands, Glass, site (19) differed somewhat in having some lower-growing calcicolous herbs, e.g. *Galium verum*, *Linum catharticum*, *Veronica officinalis* and *Viola riviniana*. Other species with considerable cover at most sites included *Agrostis tenuis*, *Cerastium holosteoides*, *Galium aparine* and *Plantago lanceolata*."

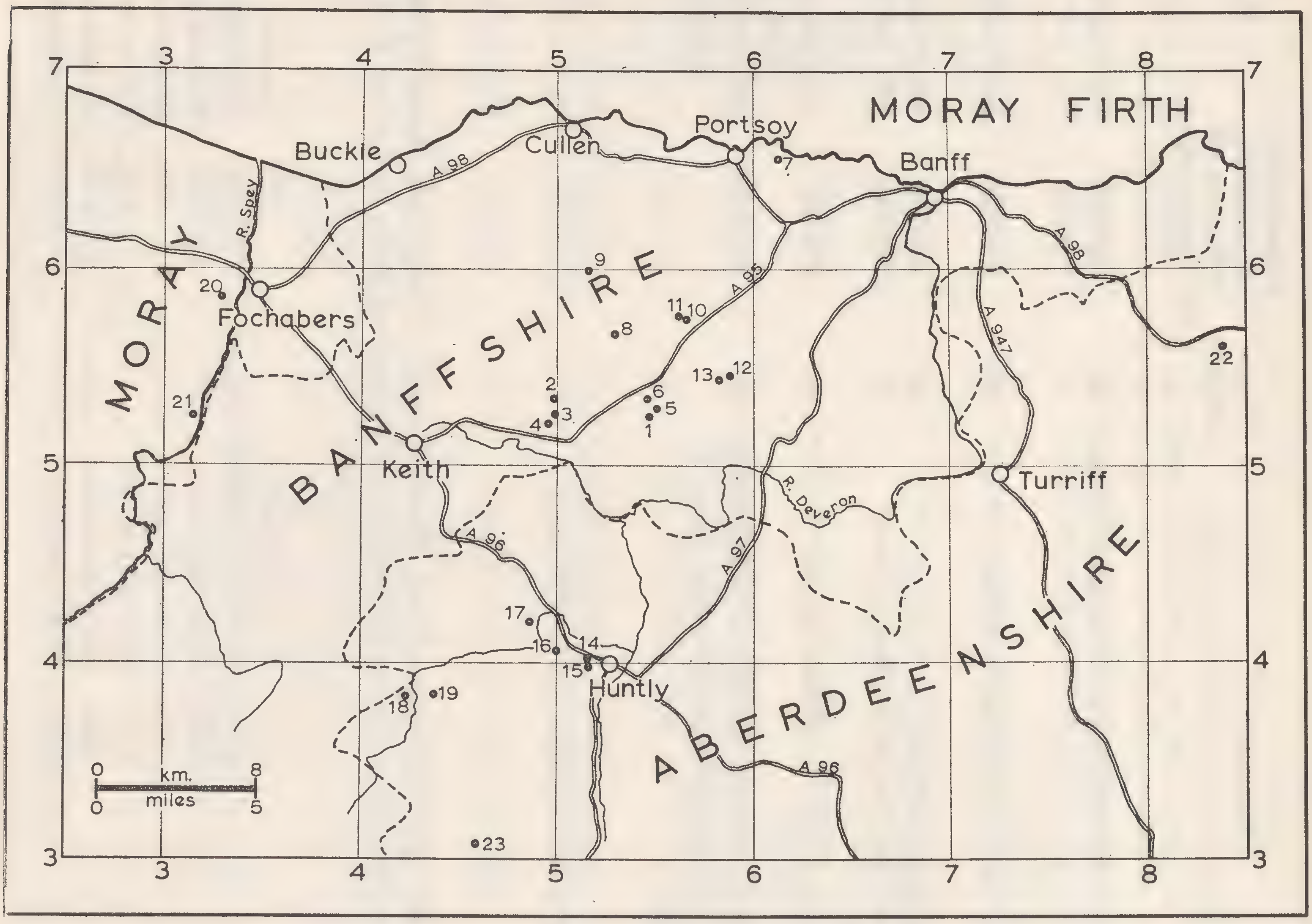

Fig. 1. Map showing localities investigated.

In Norfolk *A. agrestis* has been recorded only in low-lying marshland unlike the situations described herein which are much more varied and, whilst some are damp, none is marshy; however, a point of similarity between the two regions is the association with umbelliferous plants, although the bias in the Moray Firth area seems to be towards *Heracleum sphondylium* rather than *Angelica sylvestris* as in Norfolk (Ellis, 1967, 190). On the whole the evidence so far suggests that *A. agrestis* will be found in northeast Scotland to occupy much the same position as it does in continental areas of northern Europe.

In all cases where differentiation from *Agriolimax reticulatus* was at all uncertain from external features alone, specimens were sent to Mr. Ellis for confirmation and first captures in the two adjacent vice-counties of Aberdeen North and Moray were also forwarded. Specimens from all three vice-counties have been preserved in the British Museum (Natural History) collection. In September 1969 a single specimen of *A. agrestis* was collected in grass beside A86 in the valley of the R. Pattack c. 2 m. east of Loch Laggan, Inverness-shire.

In view of the difficulty of differentiating between this slug and *A. reticulatus* in the field, it may be of interest to note the following differences in external characters which, taken as a whole, have given me, as a beginner in the subject, a fair degree of confidence in separating *A. agrestis* from the very similar paler forms of *A. reticulatus*, especially as many tentative diagnoses have proved sound on reference to Mr. Ellis:

(1) The "daintier" appearance of *A. agrestis* quoted by Ellis (1967, 190)—my own impression is that the keel is also generally more pronounced in this species.

(2) The "rather sunburnt" appearance of *A. agrestis*—a phrase used by Mr. Ellis in a private communication advising me on hunting for this slug and a most apt description of the tan suffusion generally present on the mantle and around the keel of mature *A. agrestis*.

(3) Slight differences in the character of the slime, that of *A. agrestis* tending to be brilliantly white or bluish-white and very sticky whilst that of *A. reticulatus* tends to be duller and more slippery. It was found, for instance, that dropping typical *A. agrestis* into a specimen tube from the fingers could be quite tricky whilst *A. reticulatus* is readily released.

ACKNOWLEDGMENTS

Apart from the contributions to this paper already cited in the text, namely by Mr. A. E. Ellis of Carshalton, Surrey, by Dr. M. P. Kerney of Imperial College, London, and by Mr. D. Welch of Banchory, Aberdeenshire, I am indebted to Dr. Mary Pugh of Imperial College for preparation of the excellent copy of my locality map submitted for publication.

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Ellis, A. E. 1967. *Agriolimax agrestis* (L.) some observations *J. Conch.* **26**: 189–196. (where other references are cited).

J. Conch. *27*: 110 (1970)

BOOK REVIEW

A Biology of Lower Invertebrates by W. D. Russell-Hunter, *in* Current Concepts in Biology Series. New York: The Macmillan Company, London: Collier Macmillan Ltd., pp. 181, with 57 text-figs. and 4 tables. 6¼ ins. × 9¼ ins. Paperback. Price 28s.

In this book the author has presented a concise but detailed account of all the most important features of the main invertebrate phyla from the Coelenterata to the Mollusca. He has picked out all the anatomical and physiological characters which unite the members of each phylum and class and described them in such a way as to show how fundamental and diagnostic these characters are for each taxon; how they are inseparably linked in each group that they characterise, and yet show an overall consistency throughout all the phyla discussed.

The information given is as up to date as possible. As the age of descriptive taxonomy draws to a close, scientists are now taking a new and broader look at the work of the past to interpret their findings in a more meaningful way. Russell-Hunter shows by example how this is done.

This book is a most valuable aid to the updating and filling-in of our previous knowledge of invertebrates, especially of the Mollusca to which 6 of the 14 chapters are devoted. It must, however, be made clear that this is not a book for conchologists. It is a students' handbook, a revision book for the final year of a B.Sc. course. It is also a "must" for biology teachers. The most immediate appeal of this book is in the diagrams, all of which leave nothing to be desired in the way of clarity. From them one can learn an enormous amount without reading the text at all.

The author begins his preface with the words: "This book like the rest of this series—is intended for the beginning student. It does not require any previous knowledge of the invertebrates, but assumes only background acquaintance with some aspects of biology". In order to test this statement I presented the book to a class of second year A level G.C.E. candidates. Their comments, often rather luridly expressed, were unanimous. They said that the diagrams were clearly understandable to the dullest mind; that the book was a "mine of information"; that it was certainly not a beginners' book, and that the scientific jargon used was unnecessarily sophisticated. This latter point is the main drawback. One needs to have a fairly comprehensive biological dictionary at hand when reading this book.

Michael Block

J. Conch. *27*: 111–113 (1970)

A NOTE ON THE FAECES OF *AGRIOLIMAX RETICULATUS* (MÜLLER)

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(*Read before the Society*, 18 *October* 1969)

The form of molluscan faeces has been studied from a systematic point of view (Moore, 1931a, 1931b), from a physiological standpoint (Carriker, 1946), to determine food materials (Frömming, 1954; Pallant, 1967), and as an indication of quantity of food eaten (Hunter, 1953; Pallant, 1967). Moore was concerned with several marine species, Carriker with a single freshwater species, *Lymnaea stagnalis appressa* Say, Frömming and Pallant with terrestrial animals and Hunter with *Lymnaea peregra* (Müller). Van Weel (1961) states that it is well known that two forms of faeces occur in mussels and snails, one being a darker mass derived from food passing directly through the intestine and the other a lighter coloured form deposited on top and often in a zig-zag ribbon, this being derived from the midgut gland. Carriker recognises three forms of faecal matter from *Lymnaea stagnalis appressa* and my colleague R. Storey (Personal communication) has observed the same three types from *Lymnaea peregra*. The three types from the *Lymnaea* spp. being derived from the intestine, the midgut gland and the midgut caecum respectively, the caecal matter forming a white ribbon in some cases.

Agriolimax reticulatus (Müller) appears to produce two types of faecal matter and the form of faeces is different in some particulars. The bulk of faecal matter, about 75–90% of the wet weight, is in the form of pellets enclosed in mucus and these are fairly regular in shape and size from any one animal. They are roughly cylindrical with flat to semicircular ends and from an animal of about 600 mg. live weight each pellet is about 0·5 mm. in diameter and about 2 mm. long. The material in these is usually compressed and consists of comminuted but apparently relatively undigested fragments, which are directly referable to the type of food eaten and from which food materials can therefore be recognised. Plant vascular tissue, fibres and epidermal hairs often appear and this is presumably material which is passed directly through the gut. This form of faeces seems to be constant, whether animals have fed in natural conditions or in captivity on such diets as carrot root, cabbage leaf or potato tuber. Occasionally, however, a string of mucus may be produced with very little solid matter present, such material being like the smaller fragments in the normal pellets.

The other form of faeces is quite different. This consists of a mucus sac of irregular shape containing first a dark brown liquid followed by small granules, which are lighter in colour and resemble in size the granules found in the digestive cells of the midgut gland.

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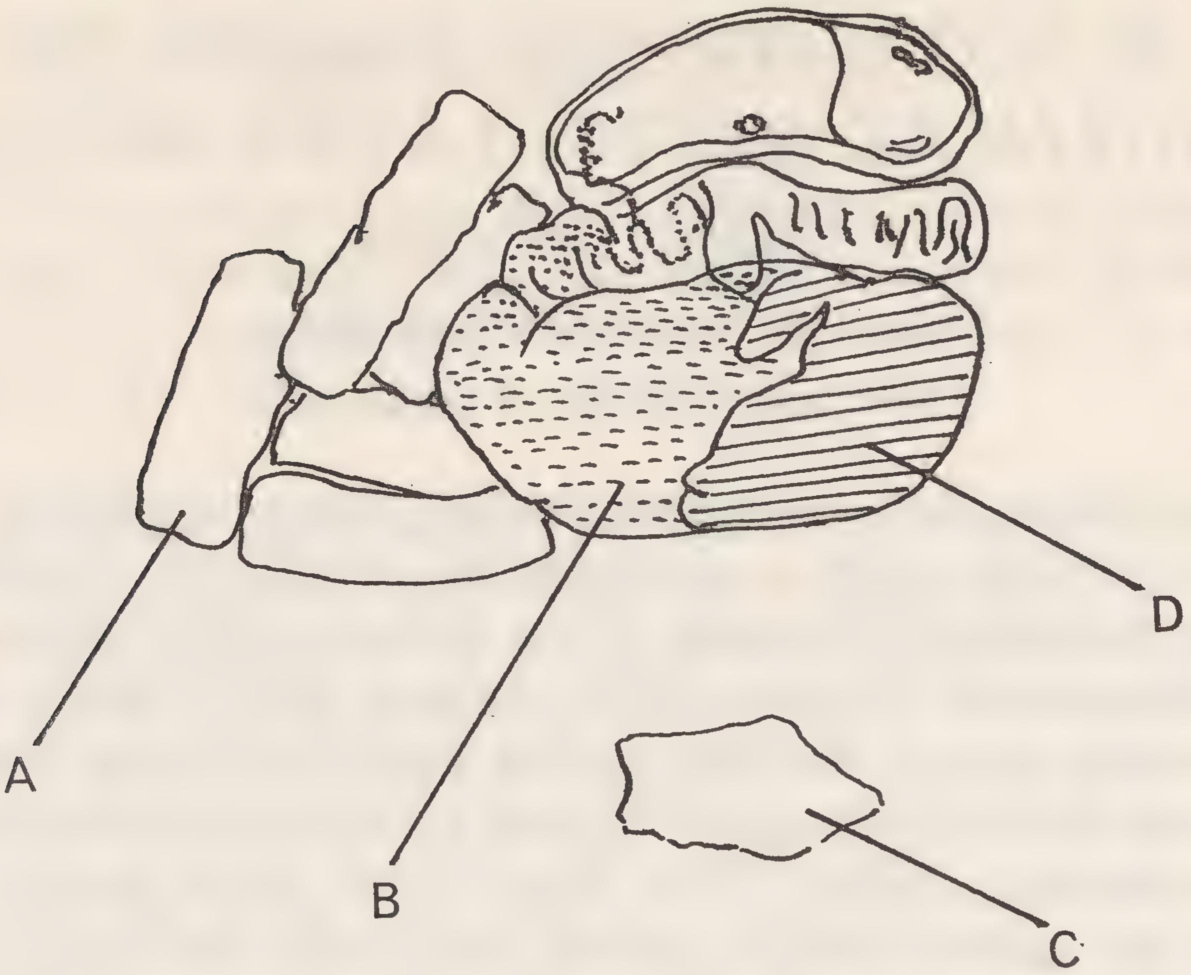

Composite deposit of faeces and uric acid from *A. reticulatus*. × 20 A, pellet; B, brown granular material; C, crystals of uric acid; D, dark brown liquid.

When the two types of faeces are deposited together, the brown matter appears first, is followed by pellets and then the white crystalline deposit of uric acid from the kidney is invariably deposited at the same time. The kidney deposit is sometimes made on top of the faeces, but often occurs a millimetre or so apart from these as the animal moves away. The figure shows a typical composite deposit of this kind. Such a deposit is made about once every 24 hours in captivity and, by animals which have fed in the field, once in the 24 hours after capture, although this timing is by no means invariable. In addition, deposits of pellets are made from time to time without either of the other types of material.

Freshly caught animals of this species deposit on average 11·6 mg. weight of faeces or 40 micrograms dry weight per milligram dry weight of animal per 24 hours. These figures were obtained from 53 animals of average live weight 269 mg. and represent the faeces deposited in the first 24 hours of captivity without further feeding. When feeding on carrot or cabbage in captivity, from 1 to 5% of the wet weight of a composite deposit is made up of the white crystalline material from the kidney, and from 10 to 20% consists of the brown deposits.

DISCUSSION

It would seem unlikely that the larger pieces of food materials ingested and not further reduced in size would find their way into the ducts of the midgut gland and that some form of sorting mechanism such as is found in other gastropods (Carriker, 1946; Storey, personal communication) might be available to prevent this. Materials not broken down sufficiently either physically by radulation and muscular activity of the foregut, or chemically by the action of digestive juices and symbionts, would presumably pursue their way through the length of the gut. Such matter compressed and wrapped in mucus would form the pellets.

The source of the brown deposits is supposed to be the midgut gland (digestive gland). Whether the brown liquid is the unabsorbed product of extracellular digestion or is secreted after intracellular digestion may be open to question. The brown granular material which follows could well be directly related to the granular components of digestive cells in the gland.

Morton (1958) refers to the accumulation of white crystalline deposits in the kidneys of land gastropods which are discharged at rather long intervals and these animals are known to be uricotelic. In *A. reticulatus* these deposits are, under the conditions observed, rarely made at less frequent intervals than the 24-hour periods mentioned.

ACKNOWLEDGMENTS

I would like to thank the Royal Society Committee for Scientific Research in Schools, under whose auspices work on slugs is being carried out at this school, and my advisors under this scheme, Dr. L. Davies and Professor M. H. Williamson. I am also grateful to Mr. Paul Rastall and Mr. Ian Fox for assistance with translations from German texts and to Mr. R. Storey for his encouragement and for unpublished information on *L. peregra*.

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J. Conch. *27*: 114 (1970)

REVIEW

We welcome a new malacological journal, this time an annual publication entitled *Malacological Review* of which No. 1 (for 1968) has just reached us. The attractive cover shows an assortment of lymnaeid shells of which *Erinna newcombii* of Hawaii and *Limnaea onychia* of Japan are discussed in two of the papers within. There are eight original papers which cover a wide field of malacological interest and include the description of a new species of *Cycloteuthis* by the Russian worker Filippova. A novel and useful feature follows, viz. reproductions of the tables of contents of 14 malacological periodicals for the year 1967, the journals listed being *Malacologia*, *Journal de Conchyliologie*, *Archiv fur Molluskenkunde*, *Journal of Conchology*, *The Nautilus*, *Proceedings of the Malacological Society of London*, *Venus*, *The American Malacological Union*, *Inc. Annual Reports*, *Basteria*, *The Veliger*, *Sterkiana*, *Comunicaciones de la Sociedad Malacologica del Uruguay* and *Journal of the Malacological Society of Australia*. The contents of the *Malacological Review* itself are also listed.

Such information, conveniently assembled, is very acceptable and we look forward to its continuance in future numbers of the *Malacological Review*. The *Review* is obtainable from: P.O. Box 801, Whitmore Lake, Michigan 48189, U.S.A., and the annual subscription is 5 dollars (U.S.A.).

Nora F. McMillan

J. Conch. *27*: 115–116 (1970)

PISIDIUM TENUILINEATUM STELFOX IN SUSSEX

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(*Read before the Society*, 18 *October* 1969)

Pisidium tenuilineatum was originally described by Stelfox (1918) from specimens collected by Oldham in the Grand Junction Canal at Cheddington and Marsworth in Buckinghamshire. The distribution and ecology of this minute species remain rather poorly known. By careful searching, Oldham subsequently found it at about seven further localities in Berkshire, Oxfordshire, Northamptonshire and Shropshire, and more recently it has been detected in Hampshire (*J. Conch.* 26: 288) and Bedfordshire (*Conchologists' Newsletter* No. 29: 102). All the British occurrences hitherto described have been in canals or sizeable rivers, but on the continent it is known also to live in lakes (Favre, 1927) and even in a shallow karstic mere (Ložek, 1956). In such environments the shell is thinner and more delicate, with less robust hinge-plate and hinge teeth, and it is apparent that the type described by Stelfox and prevalent in Britain represents an abnormally thickened riverine form, analogous to the var. *ponderosa* Stelfox of *P. casertanum*, or to the var. *crassa* Stelfox of *P. nitidum*.

In 1962 I found *P. tenuilineatum* fossil in a Postglacial (Atlantic) tufa at Brook in Kent (Kerney *et al.*, 1964). The inferred environment was that of a calcareous swamp, and the associated *Pisidium* were *P. casertanum*, *P. personatum* and *P. obtusale*. The shells of *P. tenuilineatum* were thin, like those found by Favre in Lake Geneva. In 1968 our junior member Ian J. Killeen sent me a series of *Pisidium* from a calcareous tufa of comparable age and mode of origin at Totland Bay, Isle of Wight, and here, too, a similar form of *P. tenuilineatum* was present. To these fossil occurrences, a living British station for what may be termed "normal" *P. tenuilineatum* can now for the first time be recorded.

On the 22 June 1969 Miss June Chatfield and myself visited Harting Pond, near South Harting, Sussex (v.c. 13; 41/7721). The lake is artificial, though probably of some antiquity, and has been formed by damming a stream emerging from the foot of the chalk escarpment about two miles to the south west. Possibly it may occupy the site of a pre-existing pond or swamp on the poorly-drained Gault Clay hereabouts. It is margined by extensive reed beds which have yielded the rare *Vertigo moulinsiana*, for which this remains the only known locality in Sussex (Langmead, 1946). In one of the outlets of the lake emerging as a stream just below the minor road to the east (41/781221) I collected a large series of *Pisidium*. Among these were about a dozen living *P. tenuilineatum*. The water is clean, rather shallow, with a gentle regular flow over a bottom of silty calcareous mud. There is a fair amount of aquatic vegetation. The commonest Mollusca were *Valvata piscinalis*, *Potamopyrgus jenkinsi*, *Lymnaea peregra*, *Physa fontin-*

alis, *Planorbis planorbis*, *Sphaerium corneum*, *Pisidium subtruncatum* and *P. nitidum*, with smaller numbers of *Lymnaea stagnalis*, *Planorbis albus*, *Segmentina complanata*, *Acroloxus lacustris*, *Pisidium amnicum*, *P. casertanum*, *P. obtusale* and *P. milium*. The *P. tenuilineatum* were of the thin-shelled form. At first sight they might be confused with small *P. subtruncatum*, but differ in their more regular striation, in the fact that the cardinal teeth are more less equidistantly placed between the laterals, and particularly in the presence of a peculiar hollow in the hinge-plate below the ligament pit which is a diagnostic feature of this species.

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J. Conch. *27*: 117–120 (1970)

ABIDA SECALE (DRAPARNAUD) IN THE NORTH COTSWOLDS

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(*Read before the Society*, 18 *October* 1969)

Abida secale (Draparnaud) has long been known from the Cotswolds. There are many old records (e.g. C. T. Davis, 1889, in Davis, 1953) and a specimen from Cleeve Hill is illustrated in Ellis (1926, Plate VII, Figures 8 and 9).

The purpose of this note is to publish a tetrad (2-kilometre square) distribution map of this species for the north Cotswolds based on the writer's records for November 1966 to November 1968 and to give some brief details of its habitats and associates in the area. Dr. M. P. Kerney has kindly made available a revised version of his 10-kilometre square dot map (Kerney, 1962) and this is published with an inset to show the area covered by the tetrad map.

As the tetrad map shows, the main distribution of *A. secale* in the north Cotswolds lies on or close to the western limestone escarpment of the hills. In fact it closely coincides with the distribution given for "natural or semi-natural downland" in the *Flora of Gloucestershire* (Riddelsdell *et al.*, 1948 : ix). Away from these main colonies, *A. secale* occurs at scattered localities further east down the dip-slope.

A. secale is a strict calcicole and petrophile in north Gloucestershire, as elsewhere. It is confined to sites where there is dry stony soil with little humus, and these are mostly on steep slopes where run-off is good and soil creep relatively rapid. The habitat is usually open calcareous grassland with short discontinuous turf (15 out of 23 occurrences) though the snail has also been found in dry stone walls (twice), old quarries (3 times) and open spaces in dry woodland (3 times).

Thirty-eight species of xerophile or wide ranging Mollusca were recorded with *A. secale* in the north Cotswolds. They included not only species which occurred in Britain with *A. secale* in the Late-glacial Period such as *Pupilla muscorum* (L.), *Hygromia hispida* (L.), and *Helicella itala* (L.) (Kerney, 1963), but also late comers such as *Helix aspersa* Müller and *Monacha cantiana* (Montagu). The four most frequent associates were *Helicella caperata* (Montagu), *Hygromia hispida* (L.), *Helicella itala* (L)., and *Helix nemoralis* L. in that order.

There is no clear evidence of any recent change in the status of *A. secale* in the north Cotswolds. It is possible that the increase in herbage length on the downland following the myxomatosis epidemic and the consequent reduction in rabbit grazing pressure has caused it to become extinct at one or two localities (e.g. Frocester Hill (NGR SO (32) 7900) and Haresfield Beacon (SO 8209)). The

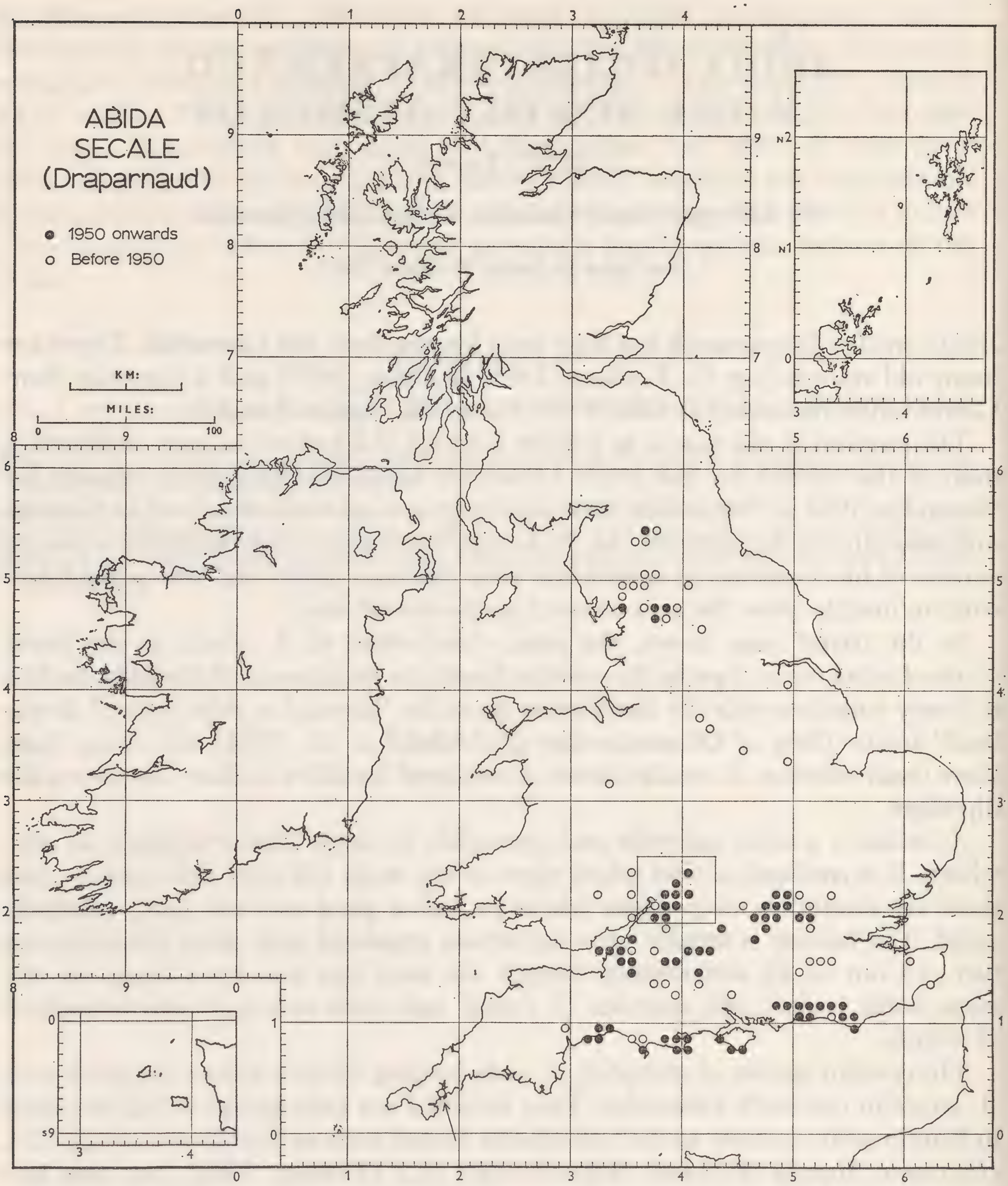

Fig. 1. Known British distribution of *Abida secale* (Draparnaud), amplifying the map given in Kerney (1962). The position of the tetrad map (fig. 2) is shown by the inset panel. Post–1950 finds of old dead shells only are regarded as 'pre-1950' occurrences. A few of the records shown on the 1962 map have been omitted or re-positioned in the light of further data (31/16, 31/91, 32/38, 32/54, 34/38, 42/44).

snail seems to be able to persist for some time in small colonies of restricted size, and in the larger colonies the proportion of dead shells to live individuals may be very high (e.g. 9 living specimens to 42 dead shells in a soil sample from

Leckhampton Hill (SO 9417) on 31 December 1967, and one live specimen to 20 dead shells in an area 30 × 30 cm. near Cleeve Hill (SO 9924) on 6 October 1968).

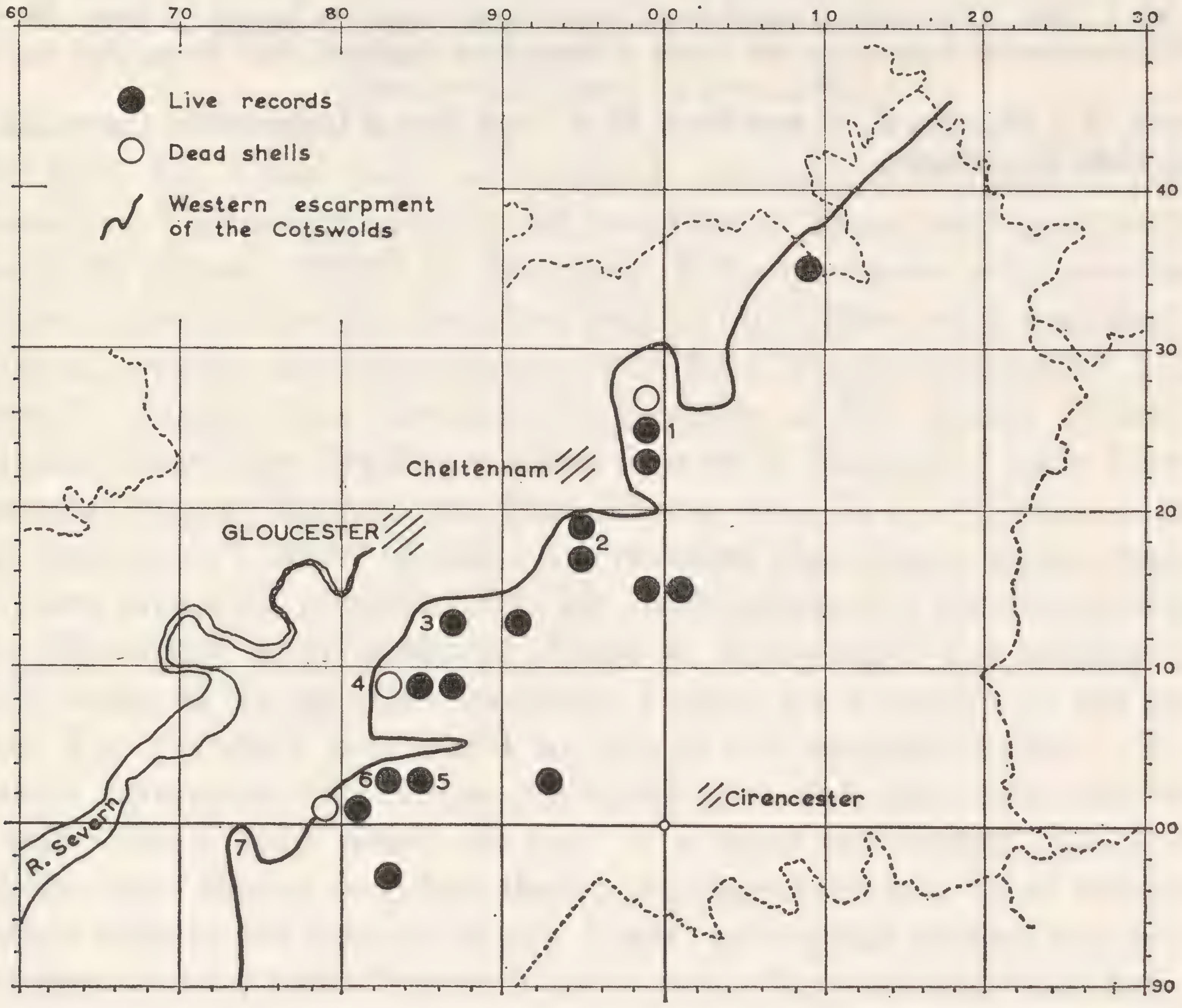

Fig. 2. *Abida secale* (Draparnaud) in North Gloucestershire, Nov. 1966–Nov. 1968.
Legend: Main areas of natural or semi-natural downland are numbered: 1, Cleeve Common; 2, Leckhampton Hill; 3, Painswick Hill; 4, Haresfield Beacon; 5, Minchinhampton; 6, Selsley Common; 7, Stinchombe Hill (not visited).

The three woodland occurrences, at Witcombe Wood (SO 9113; 10 July 1967) where Boycott also recorded it (1934: 26), Horsley Wood (ST (31) 8197; 22 October 1967), and Breakheart Hill (SO 8101; 11 August 1968), were all in fairly open situations where a closed canopy and continuous ground litter had not developed. It is an interesting possibility that *A. secale* may have survived the Post-glacial afforestation of the area in such habitats and has since spread slightly following the Neolithic and later clearances. Three of the downland sites found in 1966–8 were adjacent to old beechwoods on slopes of equal steepness to the open areas.

ACKNOWLEDGMENT

The writer is grateful to Dr. M. P. Kerney for suggesting alterations to the draft of this paper and for his help in preparing the tetrad map for publication.

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J. Conch. *27*: 121–125 (1970)

A REASSESSMENT OF SPECIES DESCRIBED FROM EAST AFRICA BY W. BLUME

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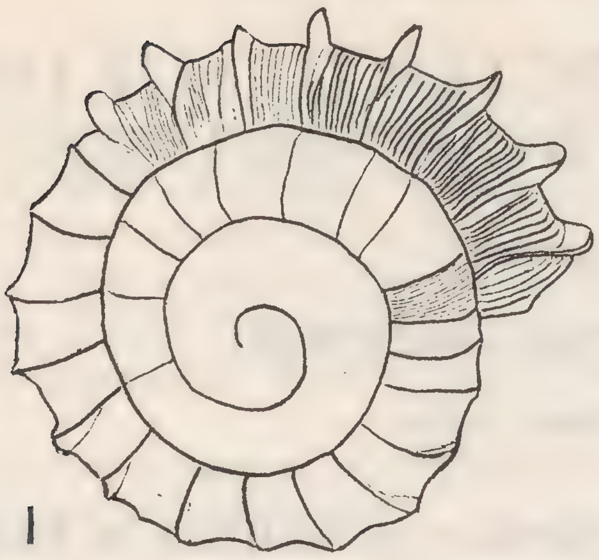
(*Read before the Society*, 22 *March* 1969)

In 1962 Prof. Dr. Franz made an excellent collection of molluscs in East Africa and elsewhere. This was studied by the late Werner Blume and a paper published posthumously (Blume, 1965). In this many of the specimens were associated with the names of species already described and certain others were described as new. The task of revising all the material would be a lengthy one which I have not had time to attempt but, through the kindness of Dr. Rosina Fechter of the Zoologische Sammlung der Bayerischen Staates in Munich, I have been able to examine the types of Blume's new East African taxa. It is important to deal with at least these since a study of them has revealed that Blume made many errors. Apart from errors of identification, his descriptions are sometimes inadequate and the dimensions he gives almost always so. Knowing of the interest of Dr. W. Adam in some of the genera concerned, I drew his attention to the paper and obtained Dr. Fechter's permission to reloan the material to him. We are in substantial agreement concerning the identity of the specimens and where we differ somewhat I have noted the fact. It is most convenient to deal with the taxa in the order Blume described them; page numbers and figure numbers given in brackets refer to the original paper. Since the original illustrations are in some cases inadequate for identification I have given diagrammatic sketches, showing some salient features to supplement them.

Acanthennea franzi (p. 6, f. 1) Fig. 4

The genus *Acanthennea* von Marts. was erected for a species occurring in the Seychelles Islands to which the snail Blume has referred to this genus does show resemblance. In my opinion, however, no mainland Streptaxid taxa can be referred to this genus. Blume's supposed species is, I think, only a minor variant of *Gulella* (*Costiguella*) *spatium* (Preston). I have had some difficulty in distinguishing *G. spatium* from *G. prestiosa* (Preston). The paratype material in the British Museum (Natural History) is poor and the lots sometimes not uniform. *G. pretiosa* itself is very variable and a wide range of shape and size could be found in the material from many localities preserved in the National Museum, Nairobi. I would not be surprised if the two names mentioned are found to apply to variants of a single species. Adam (*in litt.*) states "Blume's species is certainly very closely related to *spatium*, but without more material, I do not think it advisable to put them together. The general form of *spatium* is more cylindrical, the costulation between the big ribs finer and more numerous and the dentition is slightly different." The apertural formal is 1; 2+1(2) 0(low fold); 1(2)+1 very small.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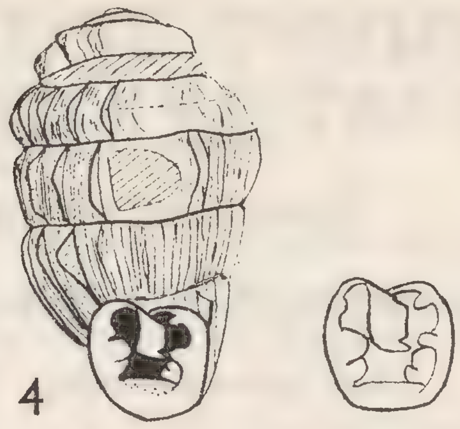
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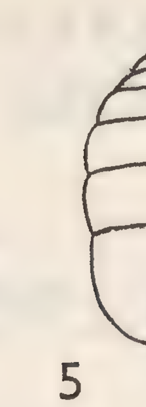
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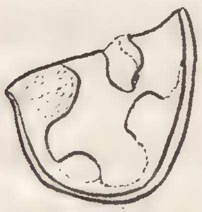
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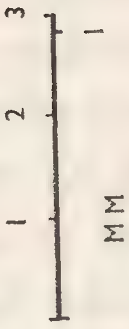

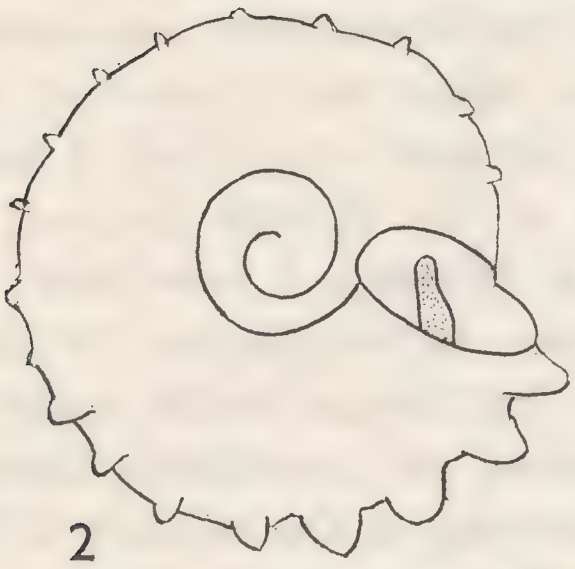
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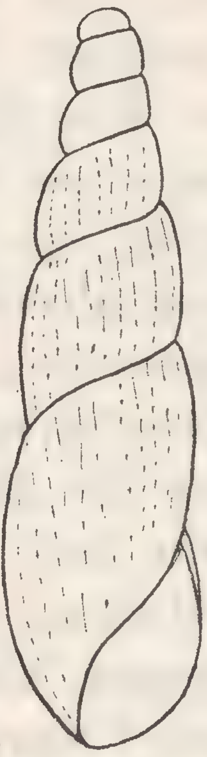
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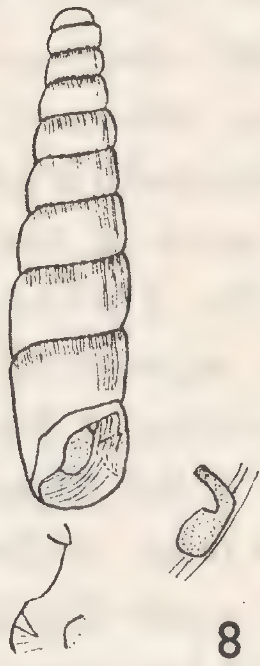
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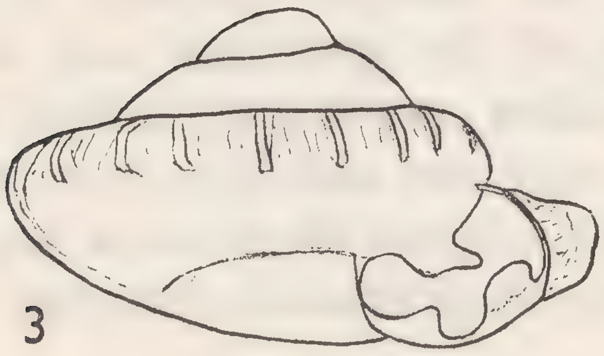
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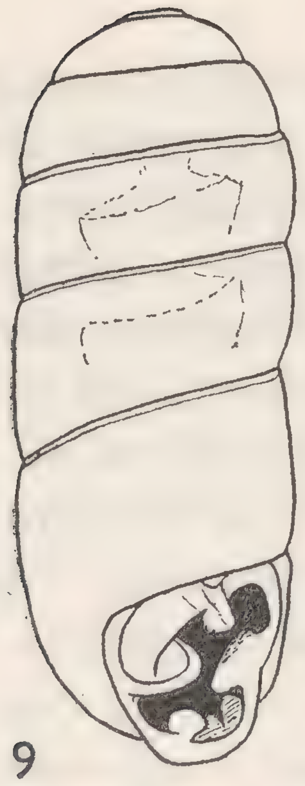
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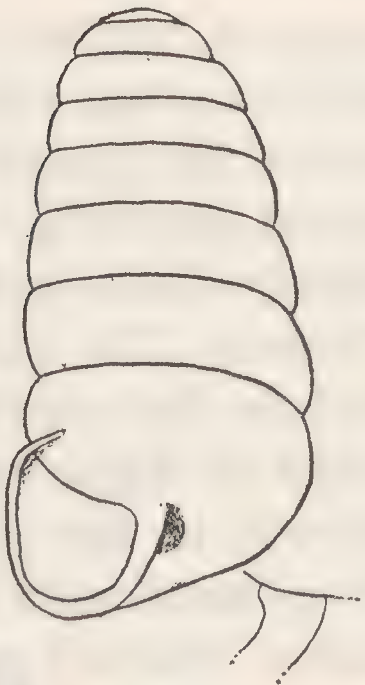
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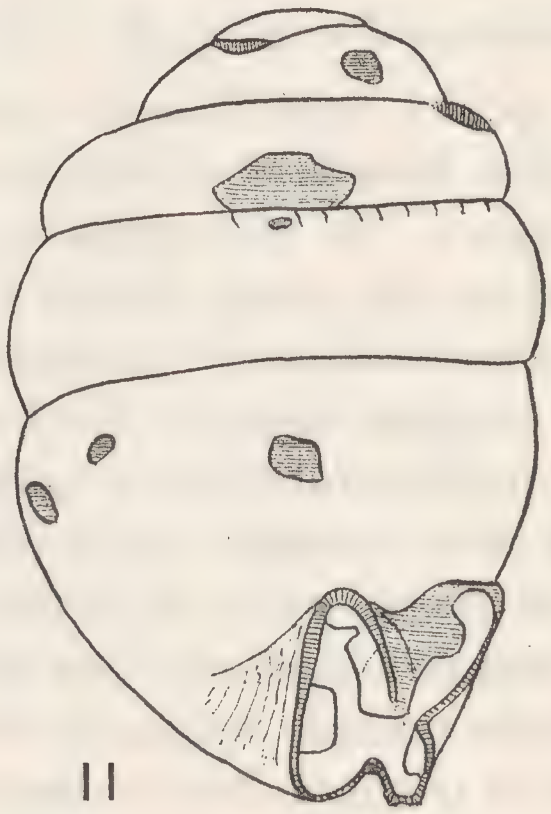
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Note for Caption:

Left-hand scale refers to 4, 5, 7, 8.
Right-hand scale refers to 1, 2, 3, 6, 9, 10, 11.

Streptostele kilimanjaroensis (p. 6, f. 2) Fig. 8

This is a curious and very distinct species and undoubtedly had not been described previously. The low raised characteristically shaped platform, well inside on the outer wall of the aperture, makes recognition easy but it is not easy to decide what genus it should be placed in. I first considered it should be placed in *Streptostele* subg. *Raffraya* but Dr. Adam comments as follows "but is it a *Raffraya*?—I had the same problem with my ?*Gulella hanangi*, which looks like a *Raffraya* but has a dentition resembling *Gulella pisa* Connolly. *Streptostele kilimanjaroensis* even has a fourth short lamella seen in oblique view at the inner side of the base." It is probably best to consider all three as species of *Gulella* forming a group linking that genus to *Streptostele* subg. *Raffraya*. This gradual merging of one genus with another (at least in so far as shell shape is concerned) reappears frequently in the Streptaxidae. The dividing lines may perhaps be better drawn when anatomical and other data are available.

Ptychotrema klemmi (p. 7, f. 3) Fig. 6

This is clearly *Gulella columella* (E. A. Smith). I feel possibly that my own keys (Verdcourt, 1962) may have led Blume astray. I included it in Key 8 which comprised species having the "aperture with three processes, with or without an additional interior lobe at the top of columella". In *G. columella* the lobe is so pronounced that it could easily be treated as a species with four processes and should have been placed in both keys.

Ptychotrema kilimanjaroensis (*sic*) (p. 8, f. 4) Fig. 9

This proved to be a species of *Gulella* unfamiliar to me and I am grateful to Dr. Adam for his comments—"This species is my *Gulella olkokolae*. Blume does not mention the two basal teeth in the interior which form a bilobed transverse lamella. The only difference is that in my species the subcolumellar lamella is slightly larger, which does not justify a separation. Blume's paper is dated 15 December 1965 but my paper appeared in June 1965."

Franzia sinistrorsa (p. 9, f. 5) Fig. 10

Blume placed this in the Streptaxidae but it is quite clearly from Blume's own figure very similar indeed to the shell described as *Columella pygmaeorum* by Pilsbry & Cockerell. Adam has preferred to place this in *Truncatellina* and I am indebted to him for loaning me a paratype of Pilsbry & Cockerell's species and also paratypes of his own subsp. *katangae*. *Franzia sinistrorsa* is nearest to the typical subspecies differing only in a slightly broader less tapering spire; it differs from subsp. *katangae* in its slightly longer shell, less convex whorls and less pronounced suture. Until more material has been collected to indicate the range of variation I am provisionally retaining this as *Truncatellina pygmaeorum sinistrorsa* (Blume). Not only was Blume's systematic placing sadly astray, but his description of his own type is erroneous—he mentions two "leistenförmige

Erhebungen" (palatal and parietal lamellae) which are quite imaginary. This mention made Dr. Adam doubt my identification, but after examining the type he agrees with me, stating "the shape of the aperture is as in subsp. *katangae* but the columellar lamella is deeper and not visible in frontal view".

Euonyma franzi (p. 12, f. 6) Fig. 7.

This is in my opinion the same as *Opeas* (*Nothapalinus*) *suavissimum* Connolly which was described from specimens collected near Nairobi, some 50 miles north of Kajiado, the type locality for Blume's supposed species. I have seen material of this species from Turkwell R. drift, 25 miles S.W. of Wajir and it is also recorded from Gazi and Marsabit; all six localities are in Kenya in rather dry areas.

Aberdaria franzi (p. 14, f. 7 a–c) Fig. 1–3

To anyone with an "eye for a shell" this is immediately recognisable as a juvenile of the taxon Blume described as *Acanthennea franzi* (i.e. *Gulella* cf. *spatium*). It is particularly surprising it was not recognised as such, since the tip of the type of *Acanthennea franzi* is slightly broken showing the juvenile dentition, and this tip is clearly identical with the type of *Aberdaria franzi*. It is possible that juvenile dentition may be of value in delimiting some sections in the genus *Gulella*—it is absent in many of the species.

Helicarion masukuensis meruensis (p. 14)

Empty shells of *Helicarion*-like snails are unidentifiable unless from well-worked localities where the *Helicarion* fauna has been worked out anatomically. To pretend that one can describe a subspecies (thus intimating that one is certain of the species) from such an empty shell demonstrates a naïvety bordering on the absurd. The type specimen suggests to me the genus *Vitrina* and Dr. Adam agrees this is likely. It will remain unidentifiable until every *Helicarion*-like species of the Mt. Meru area is known anatomically.

Gulella franzi (p. 14, f. 8) Fig. 5

This is unquestionably *Gulella insolita* (E. A. Smith) from which *Gulella aberdarensis* (Preston) is almost certainly not distinct. It is only 3·3 mm. long, not 7 as given in Blume's description.

Gulella bicarinata (p. 15, f. 9) Fig. 11

Neither Dr. Adam nor I have been able to identify this with any known species and it is probably distinct. The type (the only specimen found) is in such poor condition that it certainly should never have been described. A better description must await adequate material.

SUMMARY OF SYNONYMY

GULELLA (COSTIGULELLA) SPATIUM (Preston)
Ennea spatium Preston, *Proc. zool. Soc. Lond.* 1913 : 214, pl. 35, f. 12, 12a (1913).
Acanthennea franzi Blume, *Opusc. zool., Münch.* Nr. 90 : 6 (1965).
Aberdaria franzi Blume, *tom. cit.* : 13.

GULELLA KILIMANJAROENSIS (Blume)
Streptostele kilimanjaroensis Blume, *tom. cit.* : 6.

GULELLA COLUMELLA (E. A. Smith)
Ennea columella E. A. Smith, *J. Conch.* 10 : 316, pl. 4, f. 12 (1903).
Ptychotrema klemmi Blume, *tom. cit.* : 7.

GUELLA OLKOKOLAE Adam, *Annls Mus. r. Afriq. centr.* (*Sci. Zool.*) 138 : 34, pl. 2, f. 5 (1965).
Ptychotrema kilimanjaroensis Blume, *tom. cit.* : 8.

TRUNCATELLINA PYGMAEORUM SINISTRORSA (Blume)
Franzia sinistrorsa Blume, *tom. cit.* : 9.

OPEAS (NOTHAPALINUS) SUAVISSIMUM Connolly, *Ann. Mag. nat. Hist.* (9) 12 : 655, pl. 19, f. 32, 33 (1923).
Euonyma franzi Blume, *tom. cit.* : 12.

GULELLA INSOLITA (E. A. Smith)
Ennea insolita E. A. Smith, *J. Conch.* 10 : 315, pl. 4, f. 10 (1903).
Ennea aberdarensis Preston, *Proc. zool. Soc. Lond.* 1913 : 207, pl. 32, f. 6, 6a (1913).
Ennea keniana Preston, *Ann. Mag. nat. Hist.* (8) 7 : 464, pl. 11, f. 3 (1911).
Gulella franzi Blume, *tom. cit.* : 14.

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This advertisement is inserted with reference to the review published in the *Journal of Conchology*, vol. 26, p. 335.

23rd April 1969.

Dear Dr. Tucker Abbott,

We refer to the English edition published by us of your well-known American work "Sea Shells of the World".

We take this opportunity of apologising for a number of errors that appeared in the English edition due to mis-spelling, typographical errors and, in some cases, incorrect identification. In addition, we accept that the use by us of a later edition of the American work that the one used would have prevented other errors.

We also wish to apologise that we stated that the book was written by yourself and Dr. Herbert S. Zim whereas in fact, of course, you were the sole author.

As you know, we have withdrawn the book from circulation and destroyed all existing unsold copies.

Yours sincerely,

for THE HAMLYN PUBLISHING GROUP LIMITED

(Signed) D. H. DRING
Secretary.

J. Conch. *27*: 127–129 (1970)

ENSIS FROM THE FIRTH OF FORTH

Shelagh M. Smith

3, Meadowfield Gardens, Edinburgh 8.

(*Read before the Society*, 18 *October* 1969)

A sample of dead razor shells was collected from two localities (36/446794 and 36/448793) at about high water mark at the north end of Gosford Bay, East Lothian, on the south side of the Firth of Forth. This bay is immediately to the south of Aberlady Bay, a recognised type locality for *Ensis* sp. (van Urk, 1964), and downcurrent from it. 285 complete fresh articulated dead shells were collected at a period of calm weather on 21 May 1969. 261 complete shells, some of which were disarticulated and had to be re-paired, were unpacked on arrival home, there being a loss due to breakage of 8·5%, mostly of smaller shells despite care to pack these inside larger ones. The remaining shells were identified according to van Urk's monograph (1964) as *Ensis siliqua* (L.) 210 specimens, *Ensis minor* (Chenu) 47 specimens, and *Ensis arcuatus* (Jeffreys) 4 specimens. There were no specimens intermediate between *E. siliqua* and *E. minor*, identification and separation of the species was not difficult.

The present paper aims to show that in this area at least *E. minor* can be regarded as separate from *E. siliqua*, and that there is no reason to doubt van Urk (1964) who considered the two as separate species, although Tebble (1966) does not agree with this hypothesis.

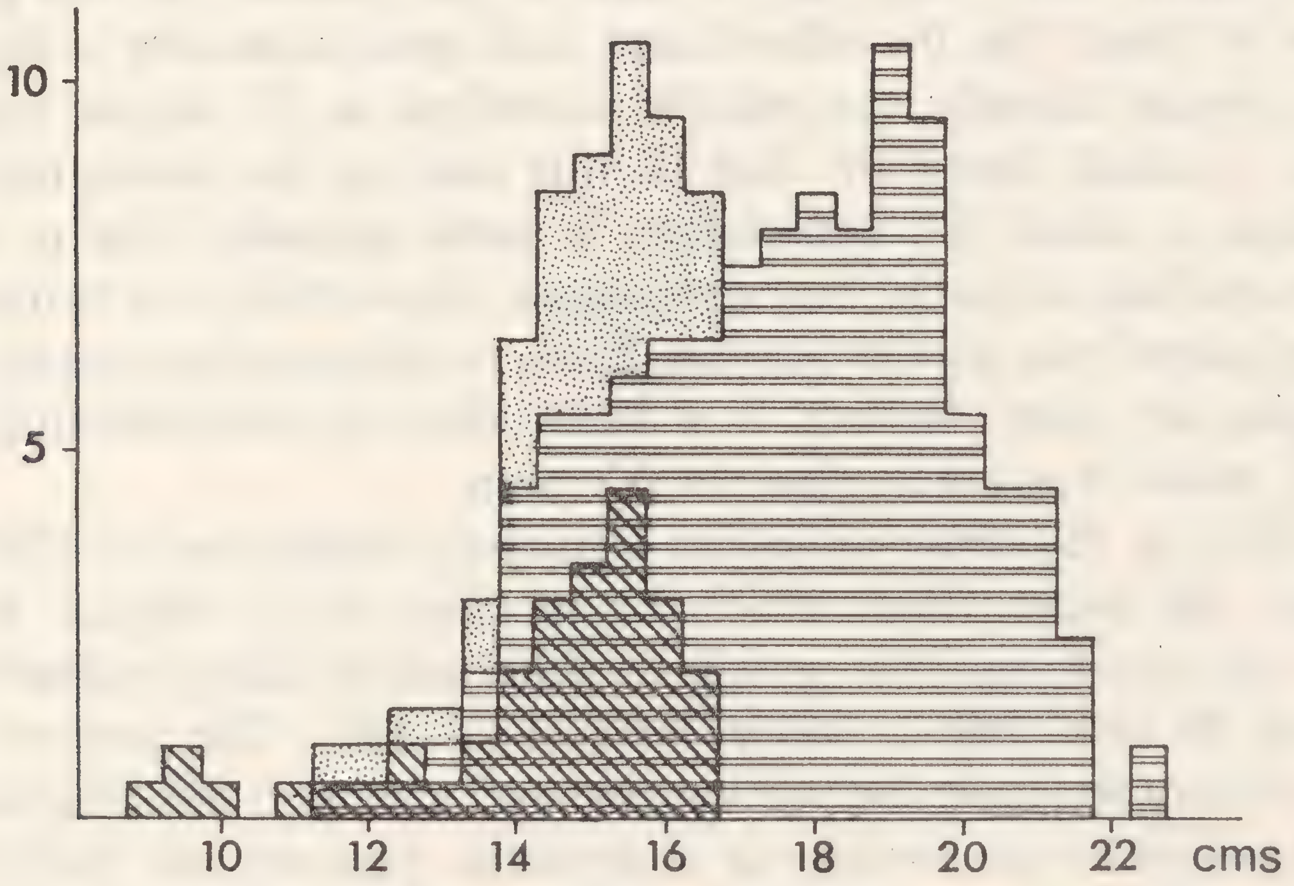

Fig. 1. Size-frequency histogram of *Ensis*. Horizontal lines: *E. siliqua*. Diagonal lines: *E. minor*. Dots: Sum of *E. siliqua* and *E. minor*.

Each articulated shell (except those of *E. arcuatus*) was measured lengthways to the nearest 5 mm., and the results were plotted as a size-frequency histogram (Fig. 1). The graph for *E. siliqua* shows a marked skew with the maximum at 19 cm., the small shells being 11 cm. and the longest 22·5 cm. long, which is not unusually large for the area. *E. minor* produced a similarly shaped graph, but the maximum is at 15·5 cm., the range being 9 cm. to 16·5 cm. The largest *E. minor* are smaller than the bulk of the *E. siliqua*, but there is still considerable overlap. The bias is in each case towards the larger adults. It is likely that this was due to a combination of three factors rather than to any one in particular. The most important reason for non-accumulation of smaller shells may have been due in part to selective destruction of live juveniles, and to breakage of these more fragile shells as shown by the loss of small shells which occurred while the sample was taken home. Also there is a higher proportion of small shells lying on the sand near L.W.M. (Shells were not collected from the sands here because they were widely scattered and enough time was not available betwen tides to collect sufficient numbers.) Since the shells were collected near the living source, and following upon the non-accumulation of juveniles due to the above factors, there was probably a natural population bias towards the optimum adult size. It has also been suggested that non-accumulation of smaller shells may have been due to sorting (Hallam, 1967). A single size-frequency histogram for all the shells is nearly symmetrical, which could indicate that if all the shells have similar dynamic properties sorting may have played a part in the accumulation of this assemblage. But the histogram is bimodal. Craig and Hallam (1963, p. 949) in their work on *Cardium edule* (L.) from the same area showed bimodalism to be due to the inclusion of different age-groups in the same sample, this factor being more pronounced the nearer the sample is to the life assemblage. The evidence of the present graph, if taken alone, suggests that the bimodalism here could also be due to the presence of two growth stages of one species of *Ensis*. On the other hand each peak coincides with the separate peaks of the groups already successfully identified as *E. siliqua* and *E. minor*, and one can conclude therefore that in this case as the size-range of the two species overlaps so much the bimodalism is more probably due to the presence of two species and not to that of two age groups. Conversely, it is further indication that there are indeed two species present. Since no intermediate forms were found, and the graphs are quite distinct, it is likely that no interbreeding between *E. siliqua* and *E. minor* has taken place in this area.

Hallam (1967, p. 29) drew up a size-frequency histogram of 176 individuals, collected from the same place, which he ascribed to *E. siliqua*. He measured the width of the shells, and the graph so obtained is fairly symmetrical with a major peak at 20 mm. and a lower peak at 28 mm. The present inference is that Hallam did not separate the two species, and although this does not invalidate his general conclusions on sorting as a dynamic process, his choice of *Ensis* is unfortunate and his remarks concerning it must be regarded with some doubt.

A considerable number of shells over and above the four specimens of *E.*

arcuatus were curved. This curvature ranged from extremely slight, sometimes affecting only one valve, to pronounced, and curvature was much commoner in *E. siliqua* than in *E. minor*. Curvature of the ventral and dorsal margins with the plane of articulation remaining straight was far less common than curvature of this plane with the ventral and dorsal margins remaining straight. The only explanation which comes to mind is that the shells were bent as they grew by the strong north-south current prevailing in the area in a manner analogous to that of trees bent in the wind.

ACKNOWLEDGMENT

I would like to thank Mr. David Heppell for drawing my attention to the problem discussed here and for reading the manuscript.

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OBITUARY

PERCY ELSTON (?–1969)

The passing of Percy Elston on the 8 September 1969 has left a gap in the list of conchologists and two societies of which he was a member are the poorer by this sad event.

The writer first became acquainted with Percy Elston, soon after he joined the Conchological Society of Southern Africa in July 1958. Thus commenced a friendship which lasted for eleven years.

At that time Percy Elston was residing in Durban, and it soon became apparent he was an active and enthusiastic member. In 1962 he was a prime mover in establishing the Natal Group, and was elected it's first Chairman. He was also first to be appointed as Country Member on the Society's Council to represent Natal Group.

At the latter end of 1963 he moved to Cape Town, and soon after was elected as a member of the Society's Council. This post he held with pride until ill health caused him to resign in 1968.

The Society was fortunate in having a member of Percy's ability to rely on. A sound man of business, he worked long and well to place the finances of the Society on a proper basis, and he lived to see this accomplished. In many other ways Percy Elston proved his worth as a member.

On occasions when the Vice-President was not available, he took over the duty of Chairman, and presided over meetings of the Council of the Society, and at monthly meetings of the Western Province (H/Q) Group.

As a collector Percy Elston possessed a small, but good, collection of shells. His main interest was in the Family Conidae, and his specimens of Natal species were all collected alive. At his request his collection will be donated to the Natal Museum, Pietermaritzburg.

Another source of pride to my old friend, was his membership in the Conchological Society of Great Britain and Ireland, which he joined in 1960. His only literary contribution to the Journal was the obituary to the late Dr. K. H. Barnard, which appeared in Vol. 25, No. 8, December 1965.

His other articles and notes were all written for the circulars of the South African Society, and were of interest to all.

Percy Elston was a veteran of the First World War, having seen service in France with a South African Regiment. He was one of the first to join the Memorable Order of Tin Hats, an important society of ex-servicemen founded in Durban some thirty years ago, and became a true and loyal member.

It appears appropriate to close these notes with a line taken from the Ritual of the M.O.H.T. Organization: "At the going down of the sun, and in the morning, we will remember him."

D. H. KENNELLY

J. Conch. *27*: 131–134 (1970)

CONCHOLOGY AND ARCHAEOLOGY. MOLLUSCA AT VERULAMIUM

L. W. Stratton
65, Park Rise, Harpenden.

(*Read before the Society*, 17 *May* 1969)

From time to time notes and papers have appeared in the *Journal* relating to the discovery of molluscs on archaeological sites. To the conchologist these are full of interest, and archaeologists are beginning to realise their significance. The finding of molluscs in some recent excavations at Roman Verulamium illustrates the way in which the archaeologist may be assisted in the assessment of his discoveries.

In 1964, during extensive excavations in Verulam Hills Fields, two infant burials were found. The second of these is of considerable importance. Below red tiles was a grave lined with 1 ft. square tiles. The following are extracts from a description of the burial, by Dr. Calvin Wells, "In the grave was the lead lining of the coffin; four iron nails still survived, one in each side where the lead had been attached to the wood.—Inside the coffin was the skeleton of a small child, together with fragments of the woollen cloak in which it had been wrapped.—A third mass of wool survived where the head of the skeleton would normally have been placed; but in two places the lead had decayed and thrust the skeleton out of its original position. The minute fragments of the skull lay on the brown fragments of decayed wool on the bottom of the coffin. The upper and lower jaws survived, and clamped between the jaws was a coin of Septimus Severus, dated to A.D. 210." Other objects in the coffin were a staff threaded with beads, the remains of a wooden box containing coloured beads, the bronze handle of a fan or toy, and a phallic amulet such as was always worn by boys until they assumed the *toga virilis* on becoming of age. There was also a small ball of gold thread, the vertebra of an ox, and a shell. The skeleton was that of a small child; the date of the burial probably later than Severus, in the first half of the third century.

There are several significant features of this burial; the lead lining of the coffin, the staff, the amulet, the woollen cloak, the gold thread and the shell. Lead linings were not uncommon, but always indicated that the occupant was a person of substance. The other articles tend to confirm this.

The shell was in two parts, one being the spire, the other part of the body whorl. The aperture was missing. It proved to be a specimen of *Murex* (*Truncalariopsis*) *trunculus* Linné, a common Mediterranean species. This, with its congenor *Murex* (*Chicoreus*) *brandaris* Linné, was the main source of the molluscan dye known as Tyrian Purple. From the Phoenicians onwards, and throughout Roman times, there was a very considerable industry in the production of this dye. This is shown by the massive mounds of *Murex* shells found at many places all round the Mediterranean as far west as Spain. The dye was very expensive to produce and was used only on the garments of people of high office, the Imperial Family, and eventually, the Emperor only (R. T. Abbott, 1963).

Original suggestions were that the cloth may indicate that the father of the dead child was a weaver, and that the shell was a plaything. The dyeing of the wool, the painstaking work in the making of the shroud, the ball of gold thread, "a luxury commodity" (Wild, 1968), together with the other circumstances of the burial, call to mind the trades of a dyer, a tailor or a cloth merchant, and undoubtedly one of some standing. Tomlin (1911) suggests that the presence of *Murex* shells in burial sites was due to their use for the extraction of dye. No other record has been found of *Murex* shells in Roman burials in Britain, so that it is possible that the presence of this shell in this particular burial may indicate a symbolic connection with the trade of the parent.

During July and August 1966 other excavations were carried out by the St. Albans Archaeological Society, under the direction of Dr. I. E. Anthony and Mr. V. R. Christophers, of the Verulamium Museum. The site was in St. Michael's Parish, close to the River Ver, and had to be completed quickly prior to building. A bastion of the wall of the Roman city, built in the third century A.D., was uncovered and many objects of Roman and Belgic origin were obtained. There were large numbers of oyster shells, but it was the non-marine molluscs, contemporary with, or possibly just prior to, the first occupation of the site, which proved to be of the greatest interest.

In one corner of the "dig", about five feet down, a wooden platform was uncovered. This consisted of tree branches, mostly hazel, some forked, all unprepared, the bark still being present. Below this was a mass of material, the remains of a watery area. The lowest part was fine black silt which had obviously been the muddy bottom of a creek or backwater of the river, which now flows some fifty yards away, but is thought to have been much closer in Roman times. The upper part of this silt contained the well-preserved shells of *Anodonta cygnaea* (Linné), some up to six inches long.

Above this the nature of the silt gradually changed. No more *Anodonta* occurred, but there were many other shells. The aquatic species were *Valvata piscinalis* (Müller), *Bithynia tentaculata* (Linné), *Lymnaea* (*Radix*) *peregra* (Müller), *Lymnaea stagnalis* (Linné), *Lymnaea* (*Stagnicola*) *palustris* (Müller), *Planorbis carinatus* Müller, *Planorbis planorbis* (Linné), *Planorbis* (*Anisus*) *vortex* (Linné), *Sphaerium corneum* (Linné) and *Pisidium amnicum* (Müller). By far the most abundant was *Sphaerium corneum*, occurring literally in thousands. One shell was found containing fry.

The succeeding layers of the deposit changed to a dark peaty substance, possibly the remains of *Phragmites*; leaves of willow and holly were also present. In this no freshwater shells were found, but there was a single specimen of *Succinea*

(*Oxyloma*) *pfeifferi* Rossmässler, together with the shells of *Hygromia* (*Trichia*) *hispida* (Linné), *Arianta arbustorum* (Linné), *Helix* (*Cepaea*) *nemoralis* Linné, *Discus rotundatus* (Müller) and *Retinella* (*Aegopinella*) *nitidula* Drapernaund. These occurred only in small numbers.

The succession of molluscs presents a clear picture of what happened over a period. At first there was an area of open water over a muddy bottom inhabited by *Anodonta*, conditions which today are favourable to this species. Gradually the water was invaded by water weed. The mussels died out and the weed was colonised by the smaller molluscs, all of which are weed dwellers and probably came from the River Ver. Later reeds invaded the area, the weeds vanished, and the annual deposit of reed trash gradually turned it into samp and then fen, with the encroachment of land snails. At the time of the "dig" the surrounding water meadows were examined, and all the species mentioned above were found to be living there still.

It seems likely that the "platform" was laid down when the area was still very soft. Archaeological evidence gives a possible date for the deposit at the beginning of the first century A.D. The site may have been abandoned for a time. Later there was some in-filling with rubbish, and in this was found a single shell of *Helix aspersa* Müller.

In another part of the excavations a chalk bank dating from the third century was uncovered. Although chalk underlies the whole area, there is none at the surface in the immediate vicinity, which is the flood plain of the river. Snail shells were found in the bank and proved to be an odd assortment. There was a number of *Hygromia hispida*, with single shells of *Planorbis* (*Anisus*) *spirorbis* (Linné), *Succinea putris* (Linné), *Succinea pfeifferi* and *Helix nemoralis*. All these were probably locally derived, and got in as the bank was built. There were also single specimens of *Helicella itala* (Linné) and *Helicella* (*Cernuella*) *virgata* (da Costa). These xerophilous calcicoles were obviously imported with the chalk. This may have come from no great distance, possibly from the Verulam Hills which rise to the west. Its importation suggests that the Roman builders needed more solid material than was immediately available.

One other mollusc found on the St. Michael's site is worthy of mention. This was a valve of the Dog Cockle, *Glycymeris glycymeris* (Linné). The inside is stained, and it has been suggested that it was used as a container, possibly for a cosmetic.

On many sites which have been excavated over the years at Verulamium, oyster shells have been abundant. In 1968 excavations were carried out on the site of monastic buildings to the south of St. Albans Abbey, which dates from Norman times onwards. Here also oyster shells were found, together with the shells of *Buccinum undatum* Linné and *Mytilus edulis* Linné, the last associated with fish bones in a rubbish pit.

The author is most grateful to Dr. I. E. Anthony and Mr. V. R. Christophers for allowing him to get in the way of their "diggers", and for their very considerable help with archaeological information.

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J. Conch. *27*: 135–137 (1970)

THE IDENTITY OF *CONUS MAPPA* [LIGHTFOOT], *C. INSULARIS* GMELIN, *C. AURANTIUS* HWASS IN BRUGUIÈRE, AND HWASS'S INFRASPECIFIC TAXA OF *C. CEDONULLI*

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Schenectady, New York

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(*Read before the Society, 21 March 1970*)

This paper corrects an erroneous interpretation of the nominal species *Conus mappa* [Lightfoot] (1786). Although Kohn (1964) considered *C. mappa* a junior synonym of *C. ammiralis* Linnaeus, 1758, we now consider it to be a valid species and present evidence in support of this conclusion.

The holotype of *C. mappa* is lost (Kohn, 1964), and the identity of the nominal species rests entirely on the indication in the Portland Catalogue, a reference to Knorr (1757). Re-examination of Knorr's figure (Fig. 1) and description and comparison with specimens that have become available during the past several years have convinced us that *C. mappa* should be removed from the synonymy of *C. ammiralis* and considered a valid species and a senior synonym of *C. insularis* Gmelin, 1791 (Fig. 2), *C. aurantius* Hwass in Bruguière, 1792 (Fig. 3), and Hwass's infraspecific taxa of *C. cedonulli* (Hwass and Bruguière, 1792) (Fig. 4).

Kohn (1964) stated that "the spiral rows of granules which are indicated in Knorr's figure [for *C. mappa*] and are mentioned in his description are not characteristic of *C. dominicanus*. They are characteristic of a variant of *C. ammiralis* Linnaeus, however . . .". This statement is in error. Except for badly worn specimens, all shells of "*C. dominicanus*" (=*C. insularis* Gmelin; Kohn, 1966) examined do bear transverse rows of granules (described as "beading" by Clench, 1942). Moreover, the transverse rows of granules are regularly spaced over the entire last whorl. The variant of *C. ammiralis* mentioned bears rows of granules in a band at the shoulder, but these are sparser and irregularly spaced on the abapical half of the shell.

Conus mappa [Lightfoot]

Synonymy. The following brief synonymy summarizes the most important names used to denote the species under consideration.

SMITHSONIAN INSTITUTION NOV 0 2 1970

Conus mappa [Lightfoot] 1786, *A Catalogue of the Portland Museum . . .* & c., p. 116, No. 2554.

Conus insularis Gmelin, 1791, *Systema Naturae per Regna Tria Naturae*, ed. 13, vol. 1, pt. 6, p. 3389, No. 38.

Conus cedonulli dominicanus Hwass in Bruguière, 1792, *Encyclopédie Méthodique. Histoire Naturelle des Vers*, vol. 1, p. 603. (See Kohn (1968) for other infraspecific taxa.)

Conus aurantius Hwass in Bruguière, 1792, *Encyclopédie Méthodique. Histoire Naturelle des Vers*, vol. 1, p. 606.

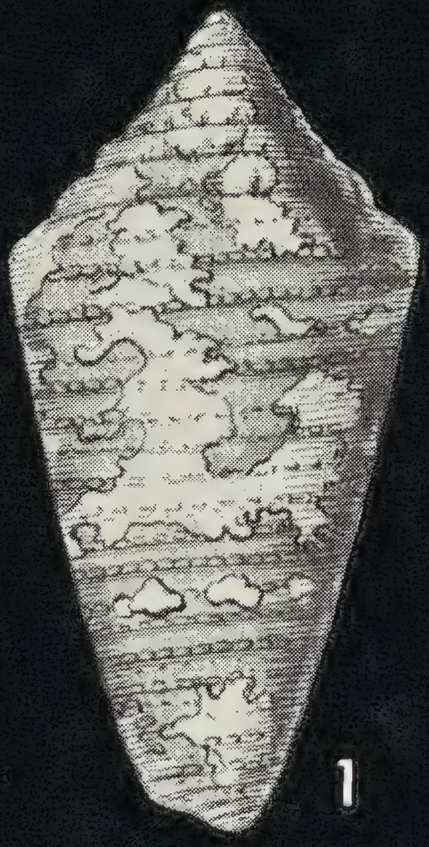
Conus cedonulli Klein. Reeve, 1843, *Conchologia Iconica*, vol. 1, pl. 9. Sp. 46. (not *C. cedonulli* Linnaeus, a name on the official Index of Rejected and Invalid Specific Names in Zoology; *Bull. zool. nomencl.*, 22 : 226, 1965.)

Conus dominicanus Hwass in Bruguière. Clench, 1942, *Johnsonia*, vol. 1, no. 6, p. 6, pl. 4, Fig. 4.

Description. Length of shell to 69 mm., usually about 40 mm. Height of spire variable; spire angle slightly obtuse; outline of spire straight to concave. Whorls canaliculate; early whorls with fine axial ribbing; edge of later whorls usually with low, rounded tubercles but shoulder nearly smooth. Last whorl conical, straight in outline, glossy, with many fine transverse lirae bearing about 11–15 granules/cm. Last whorl golden brown with irregular porcellaneous white areas sometimes tinged with pearl grey, pale blue or violet and outlined or shaded in chestnut, purple or black (light colour form; fading to golden or orange-yellow on exposure to light); or dark purplish brown (dark colour form; fading to venetian red on exposure to light) with similar white areas; with transverse rows of brown dots and dashes appearing as "strings of white beads outlined with brown and connected by a thread of brown" (Clench, 1942); sometimes with one or two transverse white bands having very complex and irregular margins. Colour pattern of spire as last whorl, with thin, dark brown axial veins at suture and usually with brown dots on the last whorls. Shell of juvenile usually like that of adults, but with simpler colour pattern, often with large, irregular, fused blotches of colour separated by bands of white blotches at the shoulder, abapical of the centre, and at the base. Periostracum thin, brown, translucent.

Specimens from Aruba, Bonaire, and Curaçao have generally been considered a distinct species, *C. aurantius* Hwass in Bruguière (Fig. 3), a conclusion Kohn (1968) tentatively accepted. However, Van Mol, Tursch and Kempf (1967) found that it is not possible to establish definitive shell criteria for separation of these forms. In specimens usually considered as "typical" *C. aurantius*, the shell is somewhat longer in proportion to its diameter, the shoulder bears more elongate and obliquely set tubercles, and the last whorl is orange or dark brown. If transverse lines are present, they are continuous rather than interrupted and encircle the granules. However, we now consider that these are not reliable as distinguishing characters and agree with Van Mol *et al.* (1967) that *C. aurantius* is a junior synonym.

Plate V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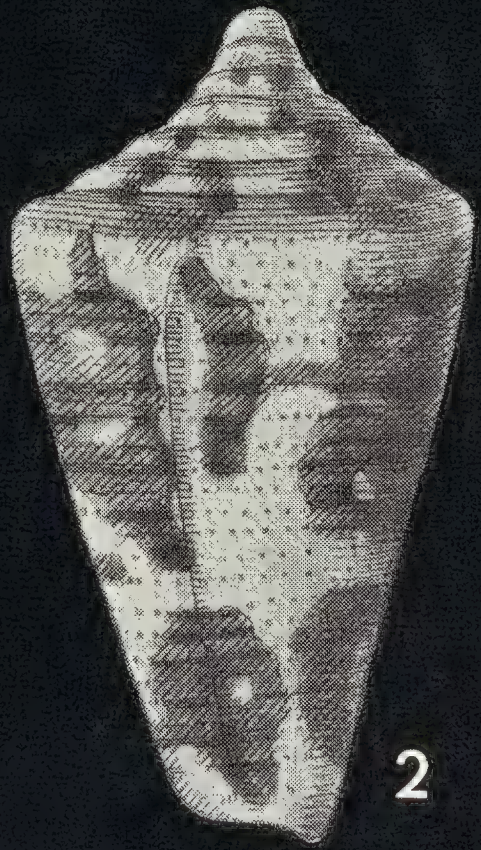
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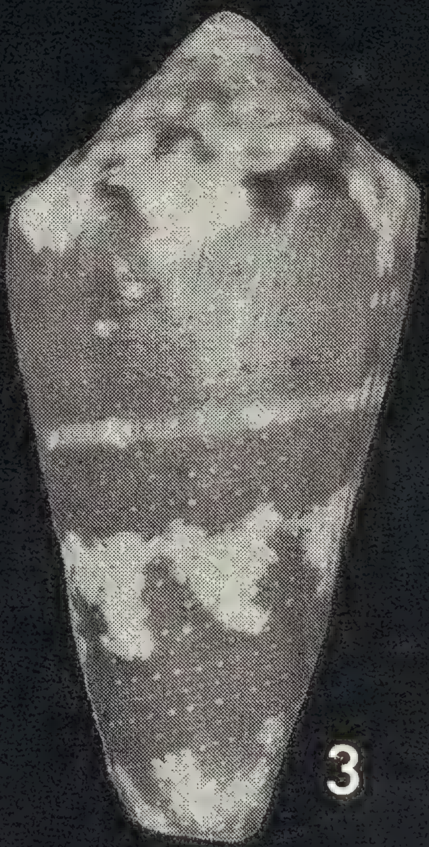
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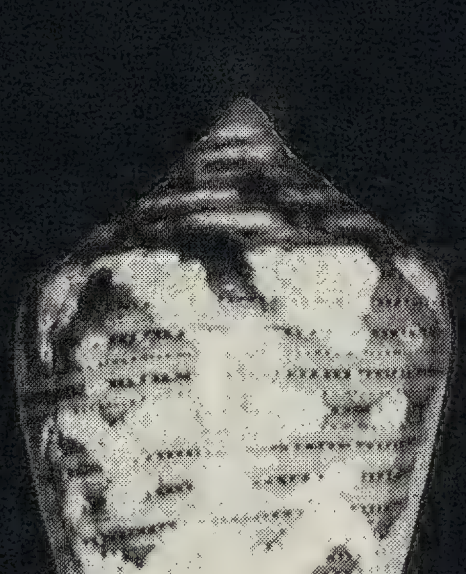
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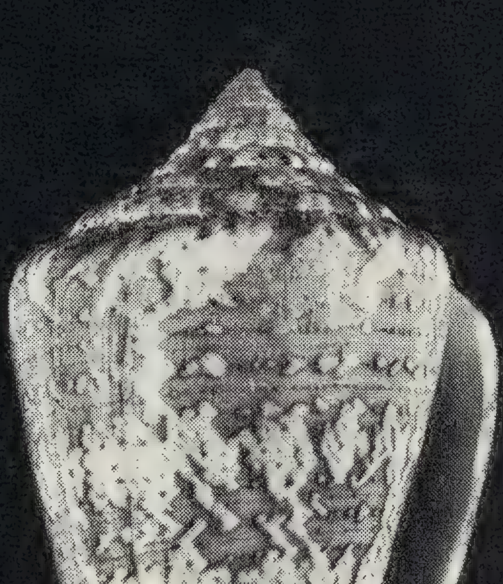
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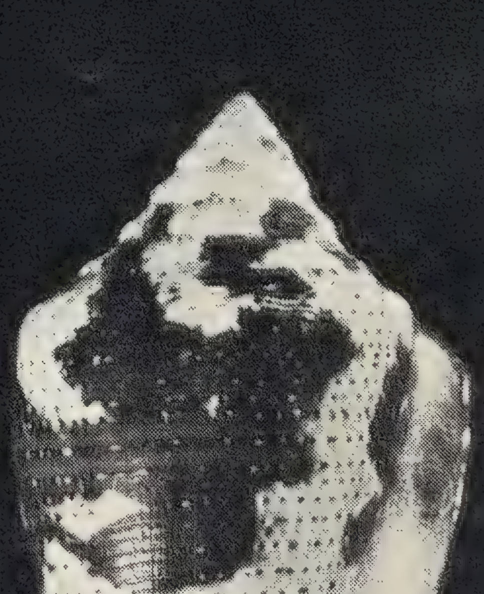
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Fig. 1. *Conus mappa* [Lightfoot]. Representative of lectotype. Reproduced from Knorr (1757: pl. 8, Fig. 4) in which shell measures 44 × 22 mm.

Fig. 2. *Conus mappa* [Lightfoot]. Representative of holotype of *C. insularis* Gmelin. Reproduced from Martini (1773: pl. 62, Fig. 683) in which shell measures 42 × 23·5 mm.

Fig. 3. *Conus mappa* [Lightfoot]. Lectotype of *C. aurantius* Hwass in Bruguière. 35·5 × 19·5 mm. Hwass Collection, Muséum d'Histoire Naturelle, Geneva, No. 1106/41.

Fig. 4. *Conus mappa* [Lightfoot.] Holotype of *C. cedonulli martinicanus* [Hwass] in Bruguière. Dominica (error for Martinique?). 42 × 22 mm. Hwass Collection, Muséum d'Histoire Naturelle, Geneva, No. 1106/60. Kohn (1968) and Mermod (1947) illustrate type specimens of Hwass's other infraspecific taxa.

Fig. 5. *Conus mappa* [Lightfoot]. St. Vincent. 67 × 36 mm. J. Holeman Collection.

Fig. 6. *Conus mappa* [Lightfoot]. Malmok, Aruba. 36 × 18 mm. D. Hiatt Collection.

At present we can offer no information on the appearance of the animal in life, nor on its habitat and habits.

Distribution. *Conus mappa* occurs throughout the Lesser Antilles and from the Gulf of Maracaibo to Rio Grande do Norte, Brazil (Van Mol, Tursch and Kempf, 1967, as *C. dominicanus* Hwass), and from the shallow subtidal zone to depths of at least 80 m. (Van Mol *et al.*, 1967). Records we have not been able to verify extend the range to the Bahamas, Cuba and the Virgin Islands. The first author has verified the following locality records: Nevis, Antigua, Dominica, Martinique, St. Lucia, St. Vincent (Fig. 5), all of the major Grenadine Islands, Grenada, Trinidad, Surinam, Aruba (Fig. 6), Bonaire and Curaçao.

Differentiation from similar species. The shell of the most similar species, *C. regius* Gmelin, differs from that of *C. mappa* in being heavier and broader in proportion to its length. Some shells of adult specimens bear rows of irregular granules basally but are not regularly beaded. The shoulder bears low, irregular tubercles, and the spire is lower, with spirally striate whorls. The typical colour is reddish brown.

SUMMARY

Conus mappa [Lightfoot], 1786, is shown to be the valid name of the species formerly known as *C. insularis* Gmelin, 1791, and *C. dominicanus* Hwass in Bruguière, 1792, and not a junior synonym of *C. ammiralis* Linnaeus, 1758, as previously reported by one of the authors. *C. aurantius* Hwass in Bruguière, 1792, is also considered a synonym of *C. mappa*, following Van Mol, Tursch and Kempf (1967).

ACKNOWLEDGMENT

Financial support from National Science Foundation Grant GB-5942X is gratefully acknowledged.

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J. CONCH. *27:* 138 (1970)

BOOK REVIEW

Conchiglie da Collezione. By Sergio Angeletti, with photographs by Carlo Bevilacqua. I Documentari N. 17 dell'Instituto Geografico De Agostini. Novara: 1968, pp. 16, 150 pls. Price 1,000 lira.

It would be no exaggeration to say that the illustrations in this book are among the finest pictures of shells which have ever been published. Superbly photographed in colour, both Gastropods and Bivalves are portrayed with great fidelity and in beautiful and minute detail. Altogether, 150 species are depicted, the majority being from the Mediterranean or from tropical waters. No attempt has been made to adhere to a uniform scale, and many shells are shown larger than life, but in every case the degree of magnification is given. The note beside each illustration also gives the general distribution of the species and the exact locality and depth from which the specimen shown was taken, together with any other special points of interest.

The shells have been chosen with care, to illustrate beauty both of form and colour, and will undoubtedly appeal to the artist, the serious student of conchology and perhaps most of all to the ordinary collector. It is unfortunate that in one or two of the cowries, with their highly polished surfaces, a rather crude attempt appears to have been made to tone down the reflection of the flash-heads, but this is a very minor criticism, and the retouching might pass un-noticed unless one is more than usually observant.

Pains have been taken to see that the nomenclature is correct throughout, but the spelling "Chlamis" for "Chlamys", "Cymbyum" for Cymbium" and "Glycymeris" for "Glycimeris" will seem unfamiliar to many. The eleven pages of introductory text, in Italian, are illustrated by line drawings, and consist of a brief account of the main divisions of the Mollusca, an explanation of the terminology of the subject and hints on the care of a collection. An index to the illustrations would have added to the usefulness of the whole.

It would not have been surprising if a volume so lavishly illustrated in colour had proved too expensive for the average pocket. In fact, the most startling thing of all about this delightful and desirable publication is that the price is only 1,000 lira, which is equivalent to 13s. 4d. at the present rate of exchange. Seldom can so much have been offered for so little, and no conchologist who sees beauty in shells can afford to be without it.

R. P. Scase

J. Conch. 27: 139–143 (1970)

SNAIL SHELLS UNDER STARLING ROOSTS

The Earl of Cranbrook

Red House Farm, Great Glemham, Suffolk.

(*Read before the Society, 31 January 1970*)

The parish of Ravenstonedale lies on the watershed between the Eden and Lune valleys in east Westmorland and between 800 and 2,000 feet above sea level. The underlying rocks are the Silurian shales which make up most of the Howgill Fells to the south and the carboniferous limestone which extends down into the Eden valley on the north. Most of the more fertile enclosed land is in permanent grass on the limestone, on some of which over the past fifty years or so have been planted a number of small areas of coniferous woodland.

In January 1966 one of these, High Wood, was taken over as a startling roost and it quickly became obvious that irreparable damage would be done unless the starling were driven away. By March that had been effected by playing "frightened starling" noises on a tape recorder, though in the event much of the wood was found to have been killed by the droppings.

The starlings driven out of High Wood unfortunately settled in another wood, Wet Hill, in the same area and in two smaller plantings about a mile away, roosting in all until the end of the "roosting season". In that short period the small plantings were completely ruined and a number of trees in Wet Hill were killed. Subsequently a heavy gale blew down a number of trees in that wood, including some of those which had been killed by roosting starlings.

In May 1969 Wet Hill was investigated. This small wood was planted in 1912 and has a dense central portion of Sitka spruce and Douglas fir with a heavy canopy and a floor entirely covered with spruce and fir needles. Outside this the margins consist mainly of Scots pine, with a more open canopy admitting enough light to produce a floor largely covered with grass. No snails or snail shells could be found in the grass under the Scots pine but under the Sitka and Douglas the ground was peppered with white, bleached snail shells showing clearly on the needles. A closer examination showed that snail shells were present in enormous numbers throughout the 4–5 cms. or so of needles and decayed needles which lay on top of the underlying clay. In some places where trees had fallen grass had come in and no snail shells were visible on the surface but when the grass was removed an abundance of shells was seen.

Working from the centre of the shell strewn part of the wood outwards until there were no shells on or below the surface a cylindrical proprietary dog-food tin with a cross section 40 square centimetres in area was thrown down in 5 casually selected inter-tree spaces, turned up on end and pressed down through the needles etc. until its mouth was plugged by the underlying clay.

The shells thus found were sorted into three categories, (i) those 5–10 mm. in width (there were none exceeding 10 mm. obtained in this way), (ii) those wider than high, less than 5 mm. in width, (iii) elongated shells, longer than wide.

The numbers found in each of the samples taken were as follows:

Sample	A	B	C	total
	5–10 mm in width	less than 5 mm. in width	elongated	
1.	60	24	20	104
2.	57	68	35	160
3.	27	45	15	87
4.	15	51	12	78
5.	11	42	7	60
In 200 sq.cm.	170	230	89	489

In addition some 5,000 cc. of casually selected samples scooped up from the surface to the underlying clay were examined: all save one of the shells found by this method were less than 10 mm. in width (*Arianta arbustorum* (Linn.) 11·5 mm. in width).

A search through the whole shell strewn area produced 29 shells exceeding 10 mm. in diameter lying on the surface, the largest 12 mm.: one of these was *Cepaea* (?) *hortensis* (Müller) the remainder *Arianta arbustorum* or *Hygromia striolata* (Pfeiffer).

No living snails were found nor any fresh shells all, even those which had originally been transparent or translucent and including those found on the surface, being blanched white and opaque, with the periostracum eroded: I am very grateful to Dr. M. P. Kerney for their identification. The vast majority, many hundreds in the material examined, were *Hygromia hispida* (Linn.) which made up most of the categories A and B in the table above, though there was in category B, less than 5 mm. in width, a considerable number of *Retinella radiatula* (Alder) and *R. nitidula* (Draparnaud). A few other species were found in very small numbers as will be seen from the list set out below. Category C, elongated shells, consisted almost entirely of *Cochlicopa lubrica* (Müller) but in this category too were found a few other species in very small numbers.

High Wood and the two small plantings used as starling roosts were not examined in detail but snail shells were either obvious on the surface or apparent when the grass which had grown over them was removed. Three other coniferous plantations in the parish which had not been used as starling roosts were examined and no snail shells were seen on the surface of the ground nor to be found when the pine needle detrius was more closely examined. The owner tells me that he has seen no snail shells on the ground in his other plantations nor does he remember seeing any in High Wood, Wet Hill and the other two affected plantings before the starling came. Few if any of the species identified there are likely to be found amongst the needles below a dense canopy of old coniferous woodland, some indeed, *Planorbis*, *Lymnaea* and *Succinea*, are normally found in freshwater or marshy areas.

I have not been able to find any references to snail shells being found under starling roosts but Head Forester, D. F. Fourt of the Soils section of the Forestry Commission's Research Station, says (*in. litt.*) that in 1954 at Wilsey Down Forest in Cornwall he saw many snail shells under a starling roost and that later at Halwell and Wilsey Down he was able to recognize old starling roosts by the snail shell layer in the litter, quite deeply buried by needle accretion since the roost was actually used.

In October 1969 a detailed examination was made by Mr. D. Elgy of the ground undernearth a starling roost in Bevercotes Block, Clipstone Forest, Notts. (Grid reference 4700 3710). Thirty sampling points were chosen by picking random numbers from a ten-yard grid placed over the area and samples taken by the method described above with a tin 75 sq. cms. in cross section. The roost, which has been occupied for three seasons, covers a considerable area of beech and a smaller area of mixed Scots and Corsican pine all planted in 1951, 27 samples were taken in the first, 3 in the second. The area most heavily contaminated by droppings was partly in pine (3 samples) partly in beech (2 samples), the remainder in beech: save in that heavily contaminated area the droppings from 1968–9 and earlier had weathered away.

The greatest number of shells was found in the central, contaminated area: these from sample covering 359 sq. cms. fell into the following categories by size:

Exceeding 10 mm. in width	2	(*Arianta*)
5–10 mm	41	
less than 5 mm.	37	
elongated	1	
	—	
total in 350 sq. cms.	81	
total in 200 sq. cms.	46	

Over the remainder of the roost there was only a shallow layer of leaf litter above the mineral soil with few, if any, remains of droppings. In 14 samples there no snail shells at all, in the remainder of the number recovered was negligible, 12 5–10 mm. in width, 5 less than 5 mm. in width, total 17 in 1,875 sq. cms. Two specimens of *Oxychilus alliarius* (Miller) were found, both under beeches, undamaged and translucent: it seems probable that these were part of the normal population. The remaining shells were like those found at Ravenstonedale damaged, bleached and with the periostracum eroded. Again I am indebted to Dr. Kerney for their identification: the species found are set out below.

Little work seems to have been done on the food of starlings or on the material found under starling roosts but Dunnett (1956) analysing the stomach contents of starlings shot at winter roosts in Aberdeenshire, found that the two main food-stuffs were leather jackets and oats. Weevils were found in small quantities but other insects, spiders and snails were found only occasionally and in very small quantities.

It seems clear that the shells found at Wet Hill must have been brought in by the starlings and voided in their droppings and probable that the same is true of those at Clipstone. Had these last been the result of an increase in numbers of the snails normally found there more undamaged shells and living snails would have been found. The numbers found at Clipstone are in line with Dunnett's findings that starlings occasionally eat snails when feeding on arable land. It is of course impossible to compare the numbers found in the various size categories with the numbers on offer in the field but the two tables do show that starlings regularly eat snails up to 10 mm. in diameter and occasionally larger ones.

The difference between the number of snail shells found at Clipstone, where the roost is three years old, and at Ravenstonedale, where it was only occupied for a few weeks, is remarkable. Since trees were killed at Ravenstonedale and not at Clipstone there must have been many more starlings at the former but the density of shells found in the central area of Clipstone roost, 46 per 200 sq. cms., is so much less than the average over the whole roost at Ravenstonedale, 489 in 200 sq. cms., as to suggest that the Ravenstonedale starlings, in an area of rough grazing and grassland, ate more snails than those at Clipstone, surrounded by arable land. It is perhaps significant that Halwell and Wilsey Down Forests, where Mr Fourt was able to recognize old starling roosts by the remains of snail shells are, Mr Elgy tells me, surrounded by open moorland and poor pasture.

REFERENCE

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LIST OF SNAIL SHELLS FOUND

	Wet Hill	Clipstone
Lymnaea truncatula (Müller)	×	—
Planorbis albus Müller	×	—
Succinea pfeifferi Rossmässler	×	—
S. ? oblonga (Draparnaud)	×	—
Azeca goodalli (Férussac)	×	—
Cochlicopa lubrica (Müller)	×	—
Vallonia excentrica Sterki	×	×
Ena obscura (Müller)	×	—
Clausilia bidentata (Ström)	×	—
C. dubia (Draparnaud)	×	—
C. sp. (fragment)	—	×
Retinella radiatula (Alder)	×	×
R. nitidula (Draparnaud)	×	×
Oxychilus alliarius (Miller)	—	×
Discus rotundatus (Müller)	×	×
Arianta arbustorum (Linn.)	×	×
Hygromia striolata (Pfeiffer)	×	—
H. liberta (Westerlund)	—	×
H. hispida (Linn.)	×	—
Cepaea hortensis (Müller)	×	—

J. CONCH. *27:* 144 (1970)

BOOK REVIEW

A Catalog of Popular Marginella Species by P. W. Clover, 1968. Size 5½ ins. by 8½ ins., pp. 16, pl. 7, paperback. Price 2 dollars.

This booklet will be welcomed by all shell collectors who are interested in the Marginellidae, for no illustrated work on this family has appeared since 1883. No fewer than 117 species are illustrated by black-and-white half-tone photographs, depicting both dorsal and ventral views of each species, while a colour photograph of the giant Marginellid *Afrivoluta pringlei* adorns the cover. All photographs are actual size, and because many of the shells are so small it is not easy with these to pick out the details of the pattern. In some cases the colour is given in the text, but in very many instances no references at all is made to the colour. Having said this, however, it is still true to say that the illustrations are a great help in identification, as they give a good idea of the size and shape, two very important characteristics.

The species listed are mostly those currently available to collectors. Classification is limited to segregating them into three general types and a "miscellaneous" section, but care has been taken with the nomenclature, and a few synonyms are given. There are useful notes on the localities where found, and the type of habitat. Values in dollars and cents are suggested in every case, and an index of specific names makes for easy reference. It is thought that this may be the precursor of a larger and more comprehensive work at some future date, but meanwhile it will certainly prove to be a useful addition to the small number of books dealing with particular groups of popular shells.

R. P. Scase

J. Conch. *27*: 145–148 (1970)

THE BRITISH DISTRIBUTIONS OF *MONACHA CANTIANA* (MONTAGU) AND *MONACHA CARTUSIANA* (MÜLLER)

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(*Read before the Society, 13 December 1969*)

Monacha cantiana and *M. cartusiana* are south-eastern species in Britain, and their distributions fall within that part of the country for which a fairly good coverage is already available under the 10-kilometre square mapping scheme. The accompanying maps (figures 1 and 2), though provisional, may therefore be regarded as giving reasonably accurate pictures of the true occurrence of these species. In addition, I have made a thorough search for old (pre-1950) records, both published and unpublished, and where such records for particular 10-kilometre squares have not been confirmed since 1950, they are shown as open circles.

(a) *Monacha cantiana* (figure 1)

M. cantiana is a vigorous colonizer of roadside verges and grassy waste places, particularly on loose well-drained soils (Chatfield, 1968). It is moderately calciphile, though its association with calcareous soils is less close than that of many other helicids, for example, *Helicella caperata* (Montagu) and *H. virgata* (da Costa). Thus it is not restricted to the chalk and limestone belts of the south-east, and is locally common in sandy country, or on clays. However, it shows a curious avoidance of the Triassic Keuper Marl of the English Midlands. There is some evidence that *M. cantiana* dislikes excessive atmospheric humidity. Mapping reveals that it becomes increasingly sporadic towards the oceanic south-west, and field observations show that it increasingly avoids river valleys and other low-lying tracts, and becomes more and more restricted to dry and well drained places. For example, it seems to be absent from the Oxford Clay country around Swindon and Chippenham, but then reappears on the higher ground to the west, in the south Cotswolds and the Mendips. Yet it is common enough in apparently similar clay tracts in the climatically drier south-east, as on the Weald Clay in Kent, or the London Clay in Essex.

Monacha cantiana is an introduced alien, having virtually no geological history in Britain. The earliest well-dated stratified context is of the third century A.D. at the Lullingstone Roman villa, Kent (52/5265). It is common in deposits of the last millenium in the south-east. The present distribution is compact and well-defined, suggesting that a balance with certain limiting factors has been

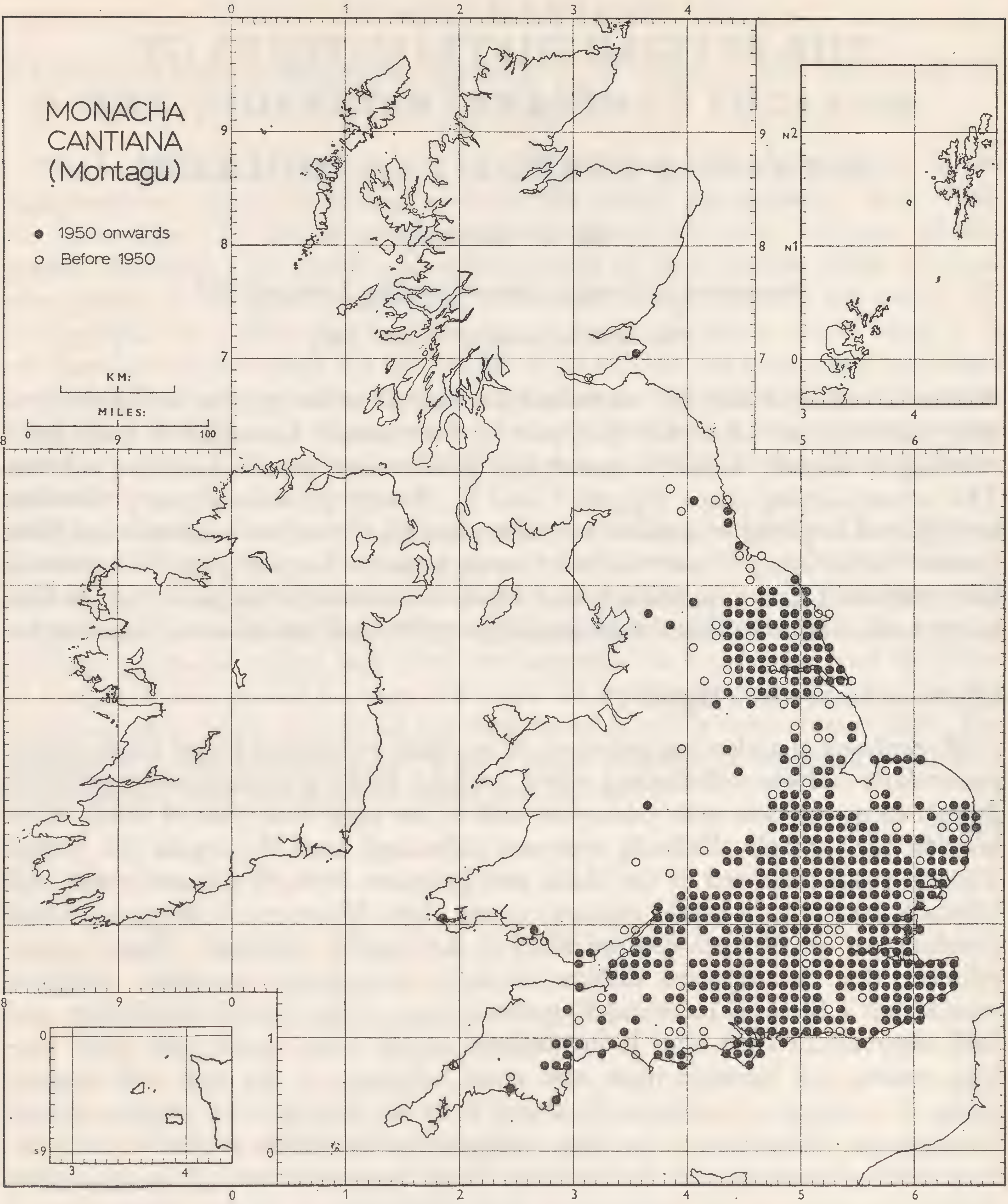
MONACHA CANTIANA (Montagu)
● 1950 onwards
○ Before 1950
KM:
MILES:
0
9
100
0
1
2
3
4
5
6
7
8
9

Fig 1.

attained. A comparison with mid and late nineteenth century records further suggests that this distribution has not changed significantly within the past century.

The two Irish vice-comital records (Ellis, 1951) have been omitted from the map; that from Dublin (Stillorgan Park) has never been confirmed and is probably erroneous; that from Cork East (Tivoli railway station, Cork city) was an introduction made in 1901 (Phillips, 1911). The colony flourished for some years but is probably now extinct (A. W. Stelfox, personal communication).

(b) *Monacha cartusiana* (figure 2)

M. cartusiana is a Mediterranean xerophile found on calcareous soils. It is rare in Britain, being virtually restricted to the chalk of coastal Sussex and easternmost Kent. The East Anglian stations are mostly listed by Stratton (1969). Records for Middlesex (v.c. 21) and Buckingham (v.c. 24) given in the census as "introductions" or "requiring confirmation" (Ellis, 1951 : 209) are both almost certainly based on errors, and have therefore been omitted from the map. A record for Cornwall (v.c. 1; *J. Conch.* **24** : 151) is similarly doubtful.

Comparison with pre-1950 information suggests that *Monacha cartusiana* is losing ground. Fossil occurrences reveal that its distribution was formerly greater, extending westwards along the chalk outcrop in Kent and Surrey, and living over a wide area in south East Anglia. Most of these fossil records come from rather late Postglacial deposits belonging within the period of prehistoric agriculture (Neolithic to Romano-British times). At Brook in Kent (61/0745) it occurs immediately above a Neolithic clearance level recently dated by the radiocarbon method at *ca* 2,590 B.C. (British Museum laboratory, assay 254; Kerney *et al.*, 1964; figure 14). *M. cartusiana* is a species commonly associated with waste ground of cultivation in France and southern Europe. Indeed, a good case can be made for regarding it as a kind of "molluscan weed", accidentally introduced into Britain by the early farming communities of the Neolithic. Its spread in south-east England would have been favoured by the relatively high summer temperatures of the Sub-boreal period (part of the Postglacial thermal optimum), and its subsequent progressive extinction may be linked with the thermal decline, probably of the order of 1°–2°C., which marked the opening of the Sub-atlantic period around 500 B.C.

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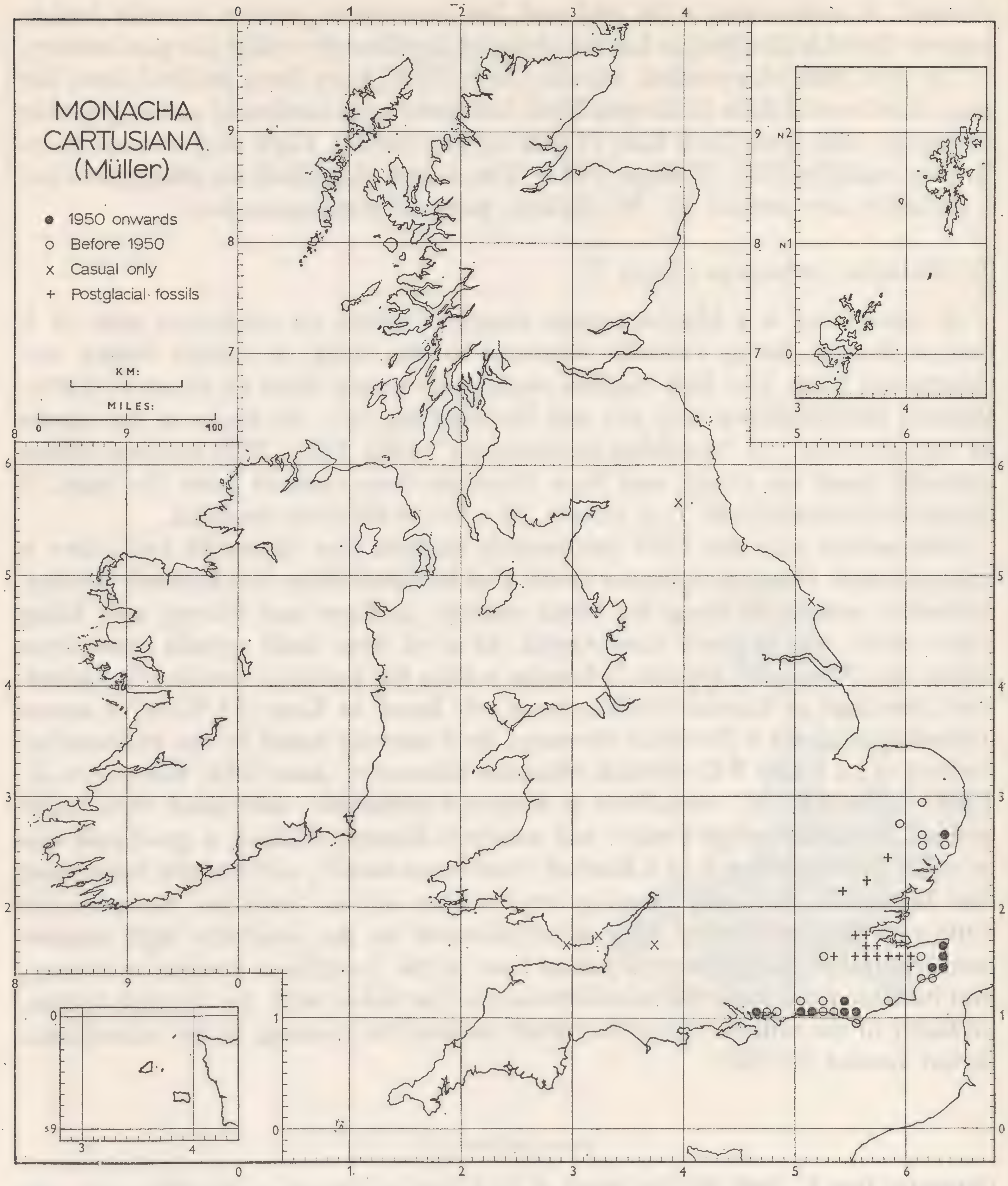
MONACHA CARTUSIANA (Müller)
● 1950 onwards
○ Before 1950
× Casual only
+ Postglacial fossils
KM:
MILES:
0
9
100

Fig 2.

J. Conch. *27*: 149–162 (1970)

NON-MARINE MOLLUSCS OF BORNEO

I. STREPTAXACEA: STREPTAXIDAE

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(*Read before the Society, 31 January 1970*)

For several years I received small bags of debris collected on scattered limestone formations in Sarawak and Sabah by Dr. G. E. Wilford of the Geological Survey, Borneo Region, Malaysia. Dr. Wilford's professional duties took him to many isolated, and often conchologically virgin, localities where there are limestone outcrops; and as opportunity allowed he gathered debris samples from them. In every sample received there were empty shells of predominantly small molluscs, and sometimes shells were present in very large numbers. M. W. F. Tweedie collected debris samples rich in shell material from similar limestone formations all over Malaya (Tweedie, 1947, 1961); and Mevr. W. S. S. van der Feen van Benthem Jutting has published a series of papers analysing and describing the shells so obtained (papers listed in the References given by Tweedie, 1961). In this way our knowledge of the non-marine molluscan fauna of Malaya has been revolutionised. It seemed to me that a similar revolution was possible for at least a part of the neglected island of Borneo, and Dr. Wilford willingly agreed to be my collector.

It has taken a long time to sift and sort the debris samples, and even longer to identify the contained shells. Much work remains but it is possible to initiate a series of contributions to our knowledge of the non-marine molluscs of Borneo. The principal objective of these contributions will be the revision of certain molluscan groups based on Dr. Wilford's material but incorporating data from other material, where available, and from published sources. It is hoped that an illustrated check-list of the non-marine molluscs of Borneo may follow. This first contribution deals with the Streptaxidae, a family of carnivorous land pulmonates.

Superfamily STREPTAXACEA

Family Streptaxidae

Historical. 1867: a single immature shell of an unlocalised "*Streptaxis*" recorded, but not described or illustrated, by von Martens (1867:387). 1874: *Huttonella bicolor* (Hutton) first recorded (as *Ennea bicolor*) from "Sarawak" by Issel (1874:52). 1884: *Ennea porrecta* (i.e. *Diaphera p.*) described from "Berge Radjang Klewang" near Bandjarmasin, S. E. Borneo (i.e. Kalimantan), by von Martens (1884). 1950: *Platycochlium sarawakense*, new genus and species, described from the Bau area of Sarawak by Laidlaw (1950).

Systematics. The material collected by G. E. Wilford and his colleagues includes only *Platycochlium sarawakense* of the species mentioned above; in addition it includes new species of *Platycochlium* (2), *Sinoennea* (2), and *Diaphera* (1). Precise locality details are available for all these taxa with the exception of those recorded by von Martens. Details of nearly all of the localities mentioned here are as provided by Dr. Wilford and are shown on the accompanying maps (Maps 1 and 2); the numbers given to the localities are repeated in the text to facilitate cross-reference.

Genus *Platycochlium* Laidlaw, 1950

(Type species, by original designation, *Platycochlium sarawakense* Laidlaw, 1950)

A genus of small molluscs with shells having the last whorl turned downwards (not upwards, as in *Tonkinia*, which it otherwise resembles). Usually strongly carinate and always glossy, with well-marked varices and oral armature typical of streptaxids, including two deep-seated palatal teeth (not mentioned in the original diagnosis). Immature forms of *Indoennea* and *Diaphera* are strikingly similar to mature shells of *Platycochlium*. The animal has not been observed. At present known only from Sarawak.

Platycochlium sarawakense Laidlaw, 1950

(Plate VI, figs. 1–2; Text fig. 1)

Shell elliptical viewed from above and below; base flattened, spire broadly dome-shaped; translucent, colourless, glossy. Whorls 5, gently sloping, suture shallow; last whorl encircled by a strong carina. Spire-whorls ornamented with irregularly-spaced, weak collabral ribs; underside of the last whorl smooth with the exception of the area around the umbilicus. Varices usually 5 in number (but varying according to the stage of growth) the last-formed varix being very conspicuous. Umbilicus wide and deep, elliptical or almost circular. Aperture trigonal, with a thickened and reflected peristome which is attached to the previous whorl; parietal lamella originates a short way inside the last whorl and projects at its posterior point of attachment where it is thickened and bifurcate. Upper lip thickened, projecting and inflected to form a distinct tooth; 2 deep-seated palatal teeth, the upper minute and ridge-like, the lower rounded and projecting towards the parietal lamella.

Dimensions (in mm.): a specimen from each of three localities measured.

Gunong Kapor 3 miles SW of Bau [1]		hill 25 miles S of Kuching [3]	Gunong Selabor 16 miles SSW of Serian [10]
width 2·40	holotype	width 2·6	width 2·4
height 1·05		height 1·0	height 1·2

Types. Holotype: British Museum (Natural History) (BMNH 1949.8.29.1). Paratypes: British Museum (Natural History): Raffles Museum, Singapore; Zoological Museum, Amsterdam.

Localities. Gunong Kapor, 3 miles SW of Bau (type locality, here restricted) [1]; Gunong Kawa (the other locality mentioned in original description), 2 miles S of Bau [1]; Gunong Doya, 2 miles SE of Bau [1]; Bra-ang Mountain, 22 miles S of Kuching [2]; hill 1 mile NE of Pankalan Ampat, 25 miles S of Kuching [3]; Wah Mountain, 23 miles S of Kuching [4]; Saak Mountain, 1 mile W of Begu, 24 miles S of Kuching [5]; Gayu Mountain, 23 miles S of Kuching [6]; 2 small hills by side of Simanggang Road, 18½ and 21 miles SSE of Kuching [7]; hill 8 miles SW of Serian [9]; Gunong Selabor, about 16 miles SSW of Serian [10].

Remarks. (See Remarks under *Platycochlium barnaclei* below.)

Platycochlium saulae n. sp.

(Plate VI, figs. 3–4; Text fig. 2)

Shell elliptical viewed from above and below; base flattened, spire broadly dome-shaped; translucent, colourless, glossy. Whorls 4½, gently sloping, suture shallow; last whorl encircled by a strong carina. Spire-whorls ornamented with strong, regularly-spaced collabral ribs, becoming obsolete half way between the suture and the carina; underside of the last whorl smooth with the exception of the area around the umbilicus. Varices usually 4 in number (but varying according to the stage of growth) the last-formed varix being very conspicuous. Umbilicus narrowly elliptical, the later whorls having grown in such a way that they largely occlude the otherwise wide and rounded umbilicus formed earlier; the thin, plate-like extensions of the last whorl which conceal most of the umbilicus are regularly ridged and resemble the fossula characteristic of many species of Cypraeidae. Aperture trigonal, with a thickened and reflected peristome which is attached to the previous whorl; parietal lamella originates a short way inside the last whorl and projects at its posterior point of attachment where it is thickened and bifurcate. Upper lip thickened, projecting and inflected to form a distinct tooth; lower lip armed with a narrow, receding tooth; 2 deep-seated palatal teeth, the upper pointed, the lower rounded, project towards the parietal lamella.

Dimensions (in mm.): a specimen from each of three localities measured.

hill 8 miles SW of Serian [9]		Wah Mountain, 23 miles S of Kuching [4]	Mas Mountain, 24 miles SSW of Kuching [8]
width 2·6	holotype	width 2·6	width 2·6
height 1·0		height 1·0	height 1·0

Types. Holotype: National Museum of Wales (NMW 70.1Z.1). Paratypes: National Museum of Wales; British Museum (Natural History); Chicago Natural History Museum; Museum of Comparative Zoology, Harvard; Senckenberg Museum, Frankfurt; Raffles Museum, Singapore; Sarawak Museum, Kuching.

Localities. 8 miles SW of Serian (type locality) [9]; Wah Mountain, 23 miles S of Kuching [4]; Mas Mountain, 24 miles SSW of Kuching [8].

Remarks. (See Remarks under *Platycochlium barnaclei* below.)

Platycochlium barnaclei n. sp.

(Plate VI, figs. 5–6; Text fig. 3)

Shell low-conical in apertural view, elliptical viewed from above and below; translucent, colourless, glossy. Whorls 5, gently sloping, suture moderately deep, last whorl rounded and with no trace of a carina. Varices usually 4 in number (but varying according to the stage of growth), each varix preceded by 7–8 prominent collabral ribs, these ribs being repeated behind the reflected lip of the aperture. Very fine, irregularly-spaced spiral striae on the later whorls. Umbilicus elliptical, very wide and deep. Aperture trigonal, with a thickened and reflected peristome which is free from the adjacent whorl; parietal lamella originates well back inside the last whorl, projects at its posterior point of attachment where it is thickened. Upper lip thickened and projecting; lower lip armed with a broad, receding basal tooth; 2 deep-seated, rounded palatal teeth project towards the parietal lamella.

Dimensions (in mm.): 3 specimens from type locality measured.

height 1·4	holotype	width 2·6	height 1·4
width 2·7		height 1·4	width 2·6

Types. Holotype: National Museum of Wales (NMW 70.1Z.2). Paratypes: National Museum of Wales; British Museum (Natural History); Chicago Natural History Museum; Museum of Comparative Zoology, Harvard; Senckenberg Museum, Frankfurt; Raffles Museum, Singapore; Sarawak Museum, Kuching.

Locality. Gunong Selabor, about 16 miles SSW of Serian (type locality) [10].

Remarks. Sufficient material was sent by Dr. Wilford to establish the presence of three species of *Platycochlium* in the area south of Kuching. The abundance of specimens in some of the samples from this area and their absence from all other samples suggests that the genus may be restricted to the south-western part of Borneo. Morphologically, mature shells of the three species diagnosed here are recognisable on sight, but the immature stages of *P. sarawakense* and *P. saulae* are difficult to separate. The presence of *P. saulae* alone in locality [9] indicates that it is not a sexually differentiated morph of *P. sarawakense*. The two species are associated in samples from localities [4] and [9] but in very unequal ratios: samples from locality [4] yielded 79 *P. saulae* and 40 *P. sarawakense*; samples from locality [9] yielded 640 *P. saulae* and 54 *P. sarawakense*. *P. barnaclei* is very different from the other two species, even in its immature stages. Samples from locality [10] yielded 120 *P. barnaclei* and 799 *P. sarawakense*.

Although the sampling was uncontrolled it is possible to draw several tentative conclusions from the material extracted from the samples. (1) *P. sarawakense* frequently occurs alone; *P. saulae* can occur alone; *P. barnaclei* does not occur alone. (2) The three species do not occur together; *P. saulae* does not occur with *P. barnaclei*. (3) *P. sarawakense* outnumbers *P. barnaclei* when the two occur together; *P. saulae* outnumbers *P. sarawakense* when the two occur together. (4) *P. sarawakense* is the most widespread species; *P. saulae* and *P. barnaclei* have a restricted distribution within the range of *P. sarawakense*.

Genus *Huttonella* L. Pfeiffer, 1856

(Type species, by subsequent designation, *Ennea kraussi* L. Pfeiffer, 1856)

This genus (by some recognised as a subgenus of *Gulella* L. Pfeiffer, 1856) is restricted to the southern half of Africa and the Comoro islands (with the exception of *H. bicolor* discussed below).

Huttonella bicolor (Hutton, 1834)

(Plate VI, fig. 7)

Specimens collected near Keningau, Sabah [12], by Mrs. Mary Saul, 26.viii.1964 (Saul, 1967: 109).

Remarks. Recorded from "Sarawak" long ago by Issel (1874: 52) this cosmopolitan species is almost certainly much more widespread than these records indicate. Described originally from Mirzapur, India, it is widely distributed throughout South-east Asia and elsewhere in the tropics. Probably Africa, or one of the islands nearby, is its true home (Jutting, 1961: 8).

Genus *Sinoennea* Kobelt, 1904

(Type species, by original designation, *Pupa strophioides* Gredler, 1881)

Shells of this genus have ovate or cylindrical shells usually with strong axial ribs. A complicated set of apertural processes is nearly always present; the palatal teeth vary in number and may be absent altogether. There are many species in India, Burma, South-east Asia and Japan. Not recorded previously from Borneo.

Sinoennea laidlawi n. sp.

(Plate VI, fig. 8; Text fig. 4)

Shell ovate, compressed antero-dorsally, transparent, glossy. Whorls smooth except for 3–4 well-defined growth rugae on the body whorl immediately above the aperture. The penultimate and anti-penultimate whorls each have two varices; these project prominently, one on each side of each whorl, and enhance the flattened appearance. Whorls 6, the penultimate the widest (the varices making it appear wider still). Suture deep. Apex rounded; base rounded. Umbilicus wide and open up to the underside of the apical whorl. Aperture vertical, quadrangular and rounded at the corners. Peristome continuous, adnate to the body whorl, thickened and reflected, outer side of columellar lip almost straight. Strong parieto-angular lamella issues from within the body whorl and projects prominently outside the aperture. Outer lip recedes to the right of this lamella, then protrudes in the middle and recedes again slightly towards the base; a small denticle projects inwards from the middle towards the parieto-angular lamella. One palatal tooth, deep set, conical; one columellar tooth, deep set, long, straight but curved abapically.

Dimensions (in mm.): 3 specimens from type locality measured.

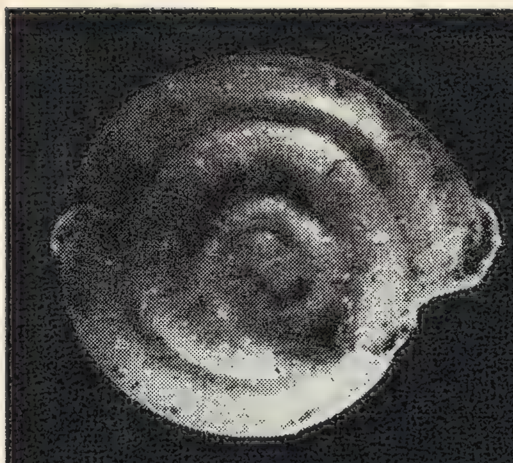
width 2·7	holotype	width 2·7	width 2·5
height 3·7		height 3·8	height 3·5

Types. Holotype: National Museum of Wales (NMW 70.1Z.3). Paratypes: National Museum of Wales; British Museum (Natural History); Chicago Natural History Museum; Museum of Comparative Zoology, Harvard; Senckenberg Museum, Frankfurt; Raffles Museum, Singapore; Sarawak Museum, Kuching.

Locality. Bukit Sarang, 20 miles SE of Tatau, 4th Division, Sarawak (type locality) [11]. M. Bong leg. 1962.

Remarks. Like the species described below (*S. bongi*) this is distinguished from all other described species of *Sinoennea* by its almost complete lack of ornament, its bulbous shape and prominent varices. Several immature examples could have been mistaken for mature shells of a different species, for each has a well-defined outer lip (which would have become a varix in maturity). In mature shells the varices are remarkably regular in position and number (always 4). The specimens vary in height and width, and the aperture is often narrower than that of the holotype. This and *S. bongi* are the only species of the genus recorded from Borneo. They form a group apart from described species of the genus, but to institute a new subgenus for their reception may be premature. It is worth noting, however, that both species come from the same limestone ridge, and preliminary studies of the associated molluscan shells indicate that it supports several other undescribed and distinctive species.

PLATE VI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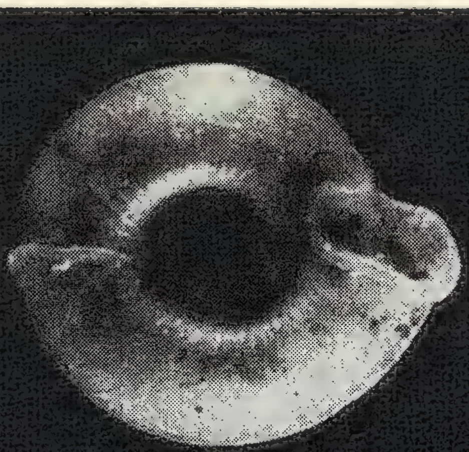
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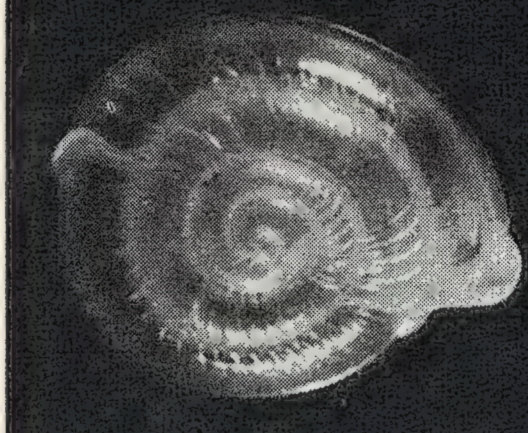
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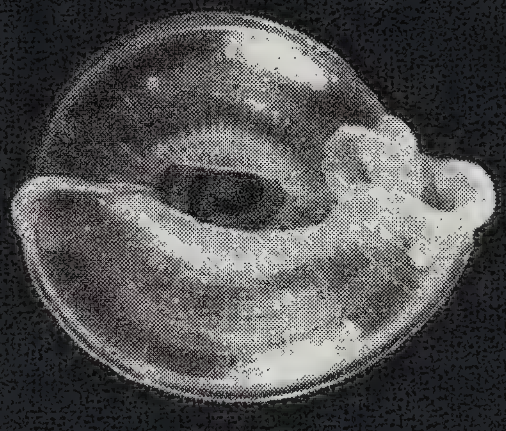
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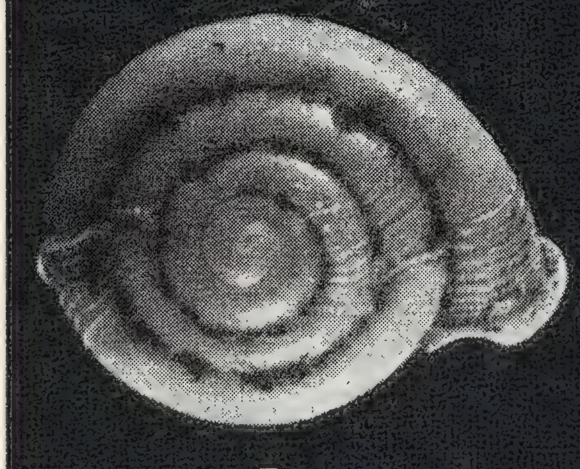
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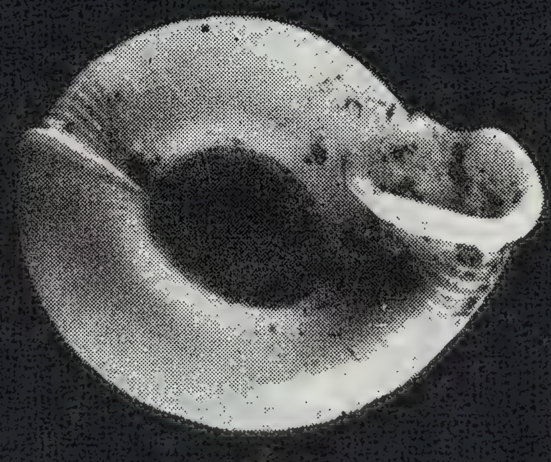
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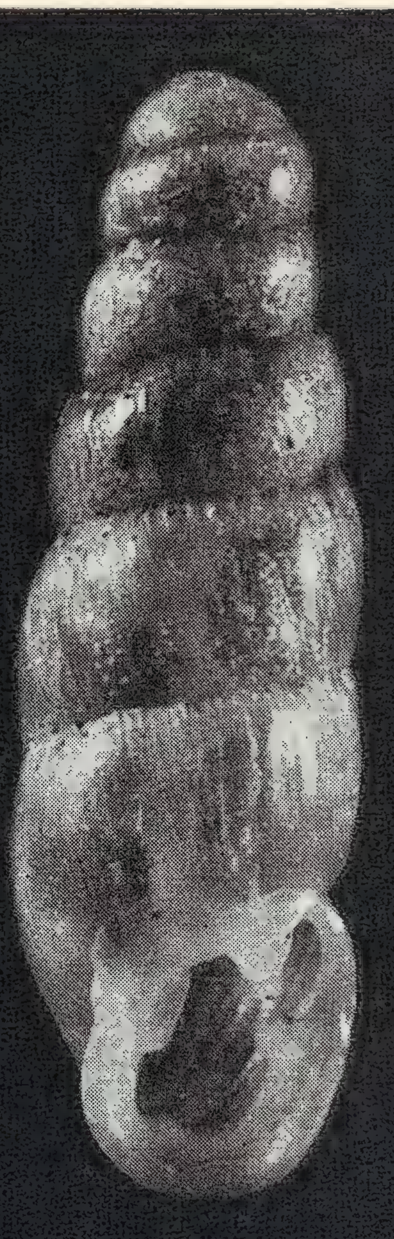
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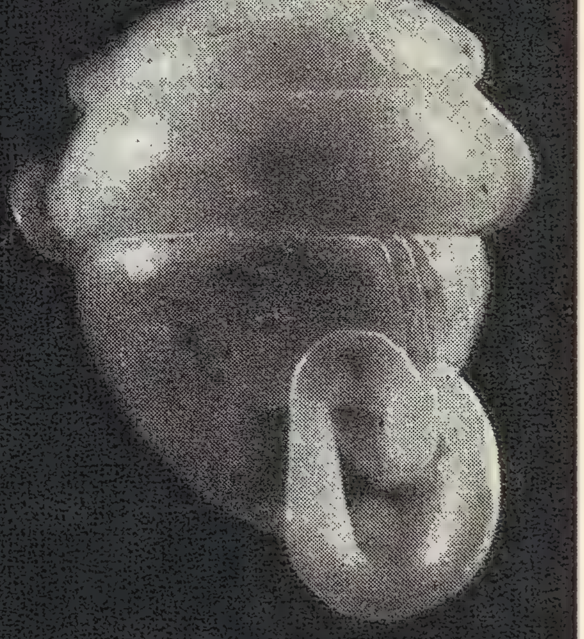
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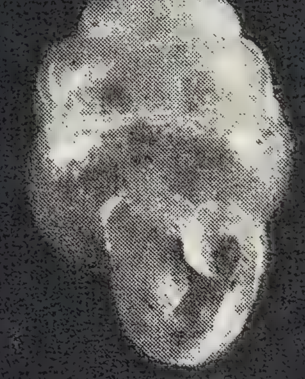
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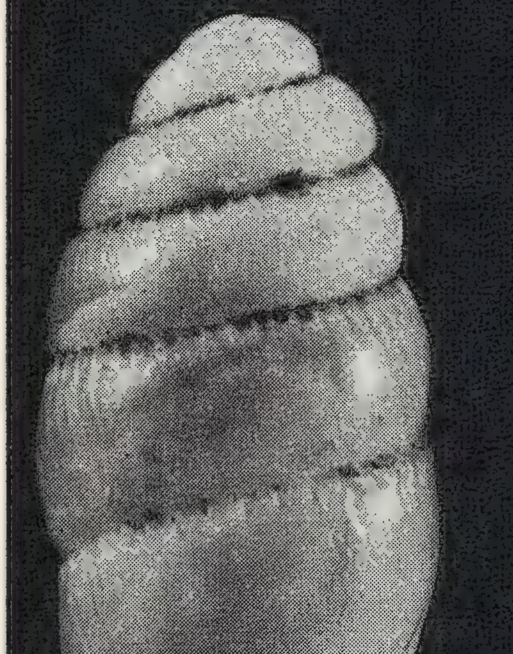
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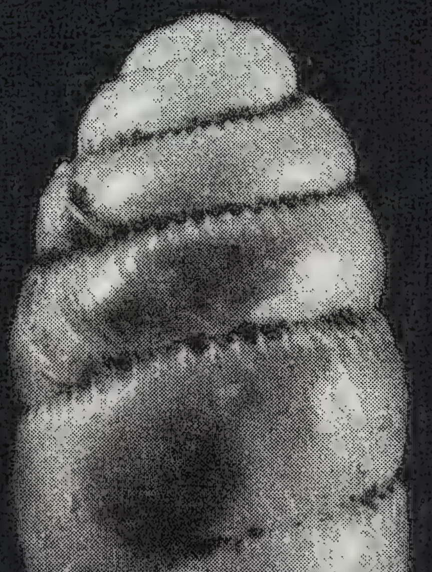
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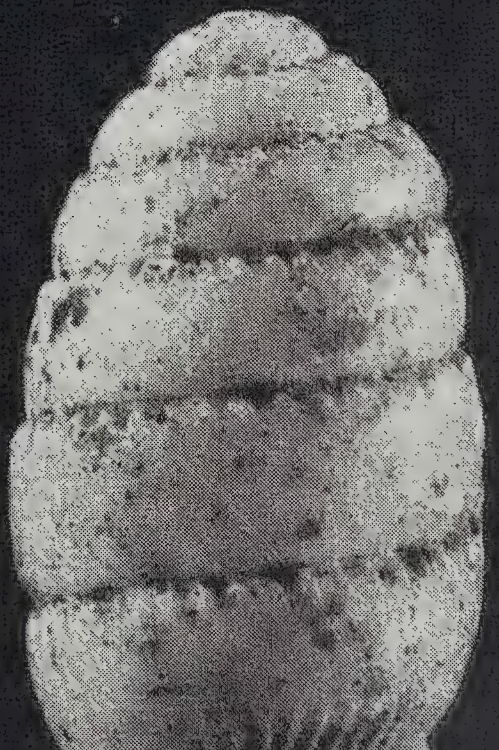
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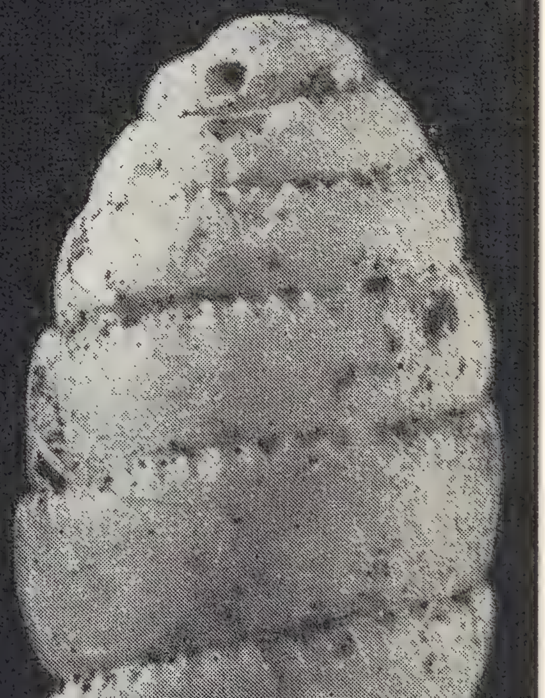
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Figs. 1–2. *Platycochlium sarawakense* Laidlaw, holotype, 2·40 × 1·05 mm. Gunong Kapor, 3 miles W of Bau [1].
Figs. 3–4. *Platycochlium saulae* n.sp., holotype, 2·6 × 1.0 mm. Hill 8 miles SW of Serian [9].
Figs. 5–6. *Platycochlium barnaclei* n.sp., holotype, 2·7 × 1·4 mm. Gunong Selabor, about 16 miles SSW of Serian [10].
Fig. 7. *Huttonella bicolor* (Hutton), 1·8 × 5·9 mm. Keningau [12].
Fig. 8. *Sinoennea laidlawi* n.sp., holotype, 2·7 × 3·7 mm. Bukit Sarang, 20 miles SE of Tatau [11].
Fig. 9. *Sinoennea bongi* n.sp., holotype, 1·4 × 2·2 mm. Bukit Sarang, 20 miles SE of Tatau [11].
Figs. 10–11. *Diaphera porrecta* (von Martens), holotype, 2·4 × 5·7 mm. 'Berge Radjang Klewang, Südost-Bornea' [14].
Figs. 12–13. *Diaphera wilfordi* n.sp., holotype, 2·6 × 6·2 mm. Limestone ridge in the Tabin Valley, about 55 miles SE of Sandakan [13].

Sinoennea bongi n. sp.

(Plate VI, fig. 9; Text fig. 5)

Shell pupoid, translucent, glossy. Whorls 5, smooth, rounded; suture deep. Body whorl and penultimate whorl have altogether 4 varices of varying prominence. Apex rounded; base rounded. Umbilicus wide and open up to the underside of the apical whorl. Aperture vertical, quadrangular but well rounded at the corners. Peristome continuous, adnate to the body whorl, thickened and reflected, outer and inner sides of columellar lip almost straight. Strong, curved parieto-angular lamella issues from within the body whorl and projects slightly outside the aperture. Outer lip recedes to the right of this lamella, then protrudes and thickens in the middle and recedes again slightly towards the base. 1 palatal tooth, deep set, conical; 1 columellar tooth, deep set, receding deep into aperture and making a widely obtuse angle.

Dimensions (in mm.): 3 specimens from type locality measured.

width 1·4 height 2·2 } holotype	width 1·4 height 2·2	width 1·4 height 2·2

Types. Holotype: National Museum of Wales (NMW 70.1Z.4). Paratypes: British Museum (Natural History); Sarawak Museum, Kuching.

Locality. Bukit Sarang, 20 miles SE of Tatau, 4th Division, Sarawak (type locality) [11]. M. Bong leg. 1962.

Remarks. Like *Sinoennea laidlawi*, described above, this species is distinguished from other members of the genus *Sinoennea* by its lack of ornament, its bulbous shape, and its varices (see also Remarks under *Sinoennea laidlawi* above.

Genus *Diaphera* Albers, 1850

(Type species, by monotypy, *Cylindrella cumingiana* L. Pfeiffer, 1845)

A genus characterised by the solute last whorl, ovate or cylindrical spire whorls, and typically streptaxid armature in the aperture. It is well represented in the Philippines, and is known also from Borneo, Vietnam, Cambodia and Burma.

Diaphera porrecta (von Martens, 1884)

(Plate VI, figs. 10–11; Text fig. 7)

This species is known only from the original shell collected between 1881 and 1884 by F. Grabowsky (Martens, 1884). A new diagnosis is given here based on a personal inspection of the holotype of *Ennea porrecta* von Martens. It is also re-illustrated here as the only published illustrations (Moellendorff and Kobelt, 1903–5: pl. 18, fig. 4) are quite inadequate.

Shell ovate, with sides of nearly equal width from the 4th whorl to the 6th; last whorl detached; whitish, translucent and fairly glossy. Apex rounded. Crenulations immediately below the shallow suture evident on all whorls except the post-apical, crenulations often being extended to form delicate prosocline riblets, those at base of last spire-whorl siuated on a sharp ridge which descends to the aperture. A varix present on the 3rd whorl and another on the 4th. Umbilicus wide and very deep. Whorls 6 (excluding the detached portion), convex, enlarging very little after the 3rd whorl. Last spire-whorl narrowed towards the base; detached portion slopes down at an angle of about 40 degrees. Viewed from the apertural side the "neck" of the detached portion has a broad, central ridge with a "gutter" running down each side; each gutter corresponds respectively to the parieto-angular and columellar lamellae within the aperture. Longitudinal threads encircle the whole neck, strongly marked on the apertural side and much weaker on the dorsal.

Aperture quadrangular-ovate in outline, with a well-reflected peristome. Strong, curved parieto-angular lamella issues from deep within the aperture from which it projects slightly: peristome to its right recedes markedly and becomes more produced in the middle where it also thickens to form a blunt denticle. 1 palatal tooth, deep set and parallel to the parieto-angular lamella. 1 columellar lamella issues from deep within the aperture and terminates just before it reaches the peristome.

Dimensions (in mm.): holotype only.

total height of shell	5·7
height minus detached portion	3·7
height of detached portion	2·0
height of aperture	1·4
width of shell	2·4

Types. Holotype: Institut für Spezielle Zoologie und Zoologisches Museum der Humboldt-Universität zu Berlin (ZMB 36914).

Locality. "Berge Radjang Klewang, Südost-Borneo" (type locality) [14]. F. Grabowsky leg. 1881–1884. N.B. The exact geographical position of this locality has not been ascertained. Inquiries of several institutions and individuals have failed to establish the existence of the name. It is most likely that it was passed on by Grabowsky to von Martens in the form of a manuscript label; von Martens probably copied the label without verifying the existence or the position of the locality it was supposed to indicate. In a later paper von Martens (1908:263) indicated that the species inhabited the area 'Bandjermassin–Mindai (S.)" which is not very helpful as Grabowsky travelled widely throughout south-east Borneo. The position assigned to this locality on the accompanying map, therefore, is tentative and may be far from correct.

Remarks. (See Remarks under *Diaphera wilfordi* below.)

Diaphera wilfordi n. sp.

(Plate VI, figs. 12–13; Text fig. 6)

Shell ovate, with sides gently curved; last whorl detached; yellowish-white, dull (but probably glossy and translucent when fresh). Apex rounded. Crenulations immediately below the shallow suture evident on all whorls except the post-apical, those at base of spire-whorl prolonged adapically. No other spire ornament. Umbilicus wide and very deep. Whorls 7 (excluding the detached portion), convex, enlarging very little after the 4th whorl. Last spire-whorl narrowed towards the base; detached portion slopes down at an angle of about 45 degrees. Viewed from the apertural side the "neck" of the detached portion has a "gutter" running down the centre; the gutter apparently corresponds to the parieto-angular lamella within the aperture. Longitudinal threads encircle the whole neck.

Aperture pear-shaped in outline, with a well-reflected peristome. Strong, curved parieto-angular lamella issues from deep within the aperture from which it projects conspicuously; peristome to its right recedes markedly and becomes more produced in the middle where it also thickens and swells. 1 palatal tooth, deep set and rounded-conical. 1 columellar lamella issues from deep within the aperture and terminates a short distance from the peristome.

Dimensions (in mm.): 3 specimens from type locality measured.

total height of shell	6·2	—holotype	5·7	6·5
height minus detached portion	4·0		3·8	4·1
height of detached portion	2·2		1·9	2·4
height of aperture	1·4		1·4	1·5
width of shell	2·6		2·6	2·6

Types. Holotype: National Museum of Wales (NMW 70.1Z.5). Paratypes: National Museum of Wales; British Museum (Natural History); Sarawak Museum, Kuching.

Locality. Limestone ridge in the Tabin Valley (a tributary of the lower Segama), about 55 miles SE of Sandakan, Sabah (type locality) [13]. G. E. Wilford leg. 1968.

Remarks. This is the second species of *Diaphera* to be recorded from Borneo. It differs from *D. porrecta* in several ways, particularly in its apertural characteristics, but both species fall naturally into the group typified by *D. moreleti* (Hidalgo) the members of which all live in the Philippines. The presence of a species of *Diaphera* in the south-east and of another in the north-east suggests that the genus may prove to be more widespread in Borneo, though it is unlikely that it is as well represented there as in the Philippines.

General conclusions. The streptaxid fauna of Borneo has now been increased from three genera and three species to four genera and eight species. Still the island has an impoverished streptaxid fauna compared with that of the Philippines to the north and Malaya to the west. Conversely, the islands of Java, Sumatra and Celebes each have fewer genera and species now than Borneo. As Borneo is the least explored of the larger islands of Indonesia (from a malacological standpoint) further discoveries are likely, particularly in Kalimantan.

Laidlaw (1950) suggested "that *Platycochlium* (and *Tonkinia*) are derivatives of an ancient stock from which the modern continental fauna has been developed". *Tonkinia* (monotypic for *T. mirabilis* Mabille, described from Vietnam) is similar to *Platycochlium* in several ways and may be closely related. More striking, however, is the similarity between mature *Platycochlium* species and immature specimens of Bornean species of *Sinoennea* and *Diaphera*. In this respect, at least, the Bornean Streptaxide (excluding *Huttonella bicolor*, which can be dismissed as an introduction) form a homogeneous group having more affinity with the streptaxid fauna of the Philippines (headquarters of *Diaphera*) than with that of the rest of Indonesia (where *Diaphera* is unknown) or South-east Asia (where *Diaphera* is very rare).

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Dr. G. E. Wilford, formerly of the Geological Survey, Borneo Region, Malaysia, collected most of the material on which this paper is based, sent maps of the areas in which collections were made, and answered my many questions. His former colleague, Mr. S. Bong, collected one of the most fruitful samples I have received. Mrs. Mary Saul sent a specimen of *Huttonella bicolor* she collected at Keningau, Sabah. Mr. G. A. S. Barnacle devoted many hours to sorting the debris samples for me. Mr. J. F. Peake of the British Museum (Natural History) let me inspect the holotype of *Platycochlium sarawakense*; and Mrs. Angela Crane of the same institution provided information and sent photocopies of published papers for my use. The holotype of *Diaphera porrecta* was lent to me by Dr. R. Kilias of the Zoological Museum, East Berlin. Dr. W. S. S. van der Feen van Benthem Jutting tried to locate "Berge Radjang Klewang" for me; and Mr. G. S. Dugdale, librarian of the Royal Geographical Society, Kensington Gore, tried to do the same. Mr. E. Broadbent was responsible for the photographs, and Miss Cynthia Merrett typed the manuscript. To all of these I am extremely grateful.

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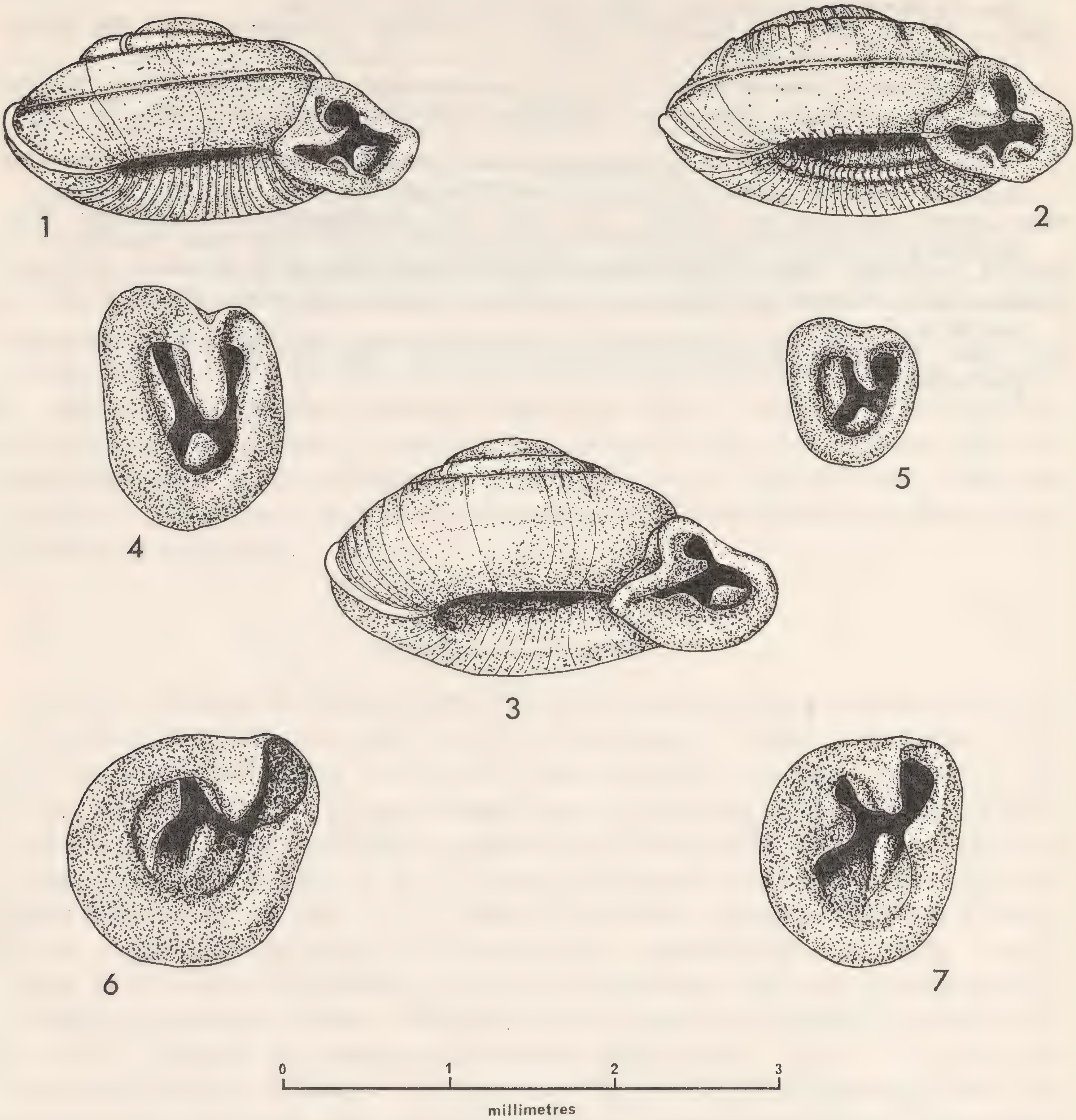
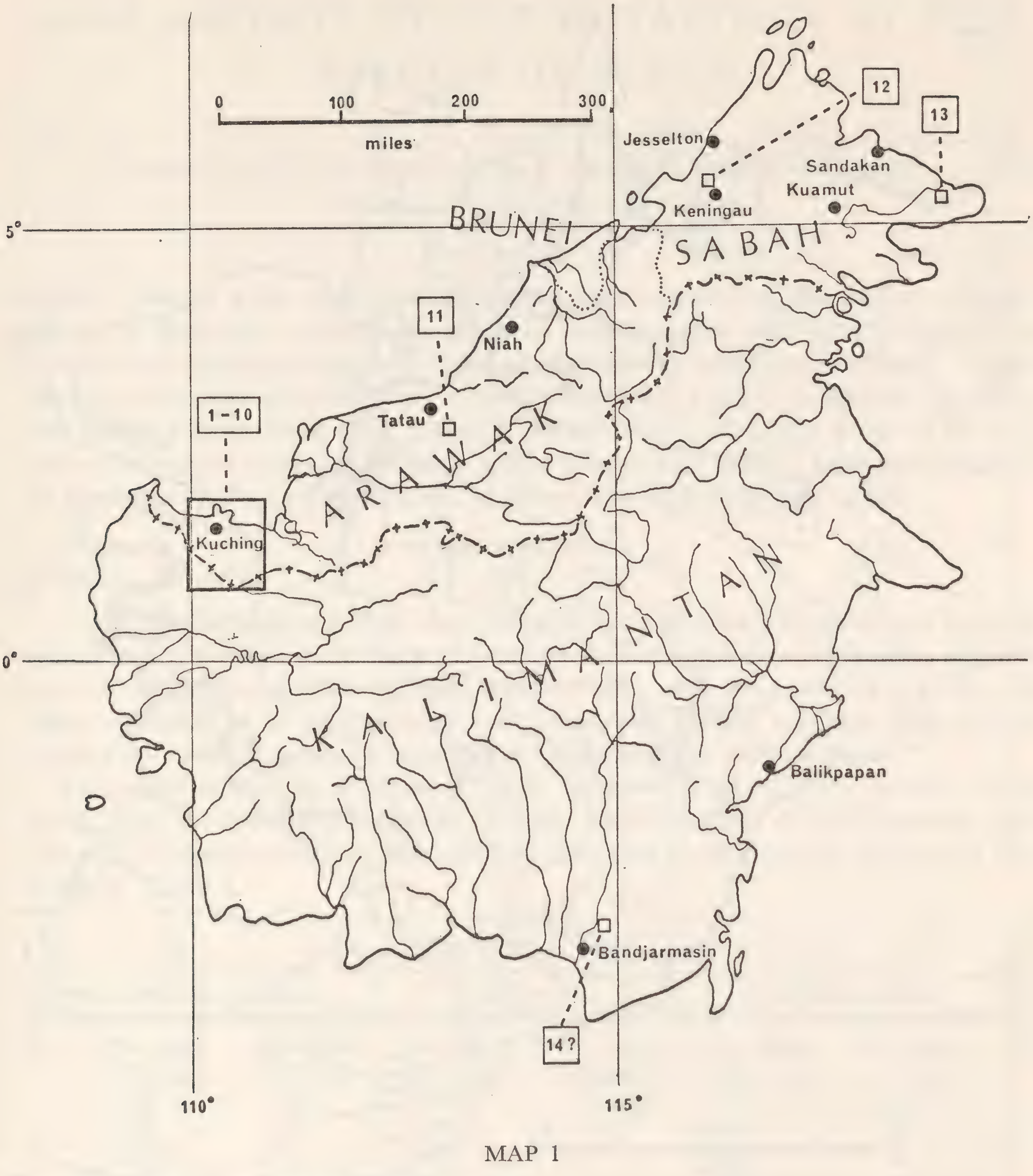


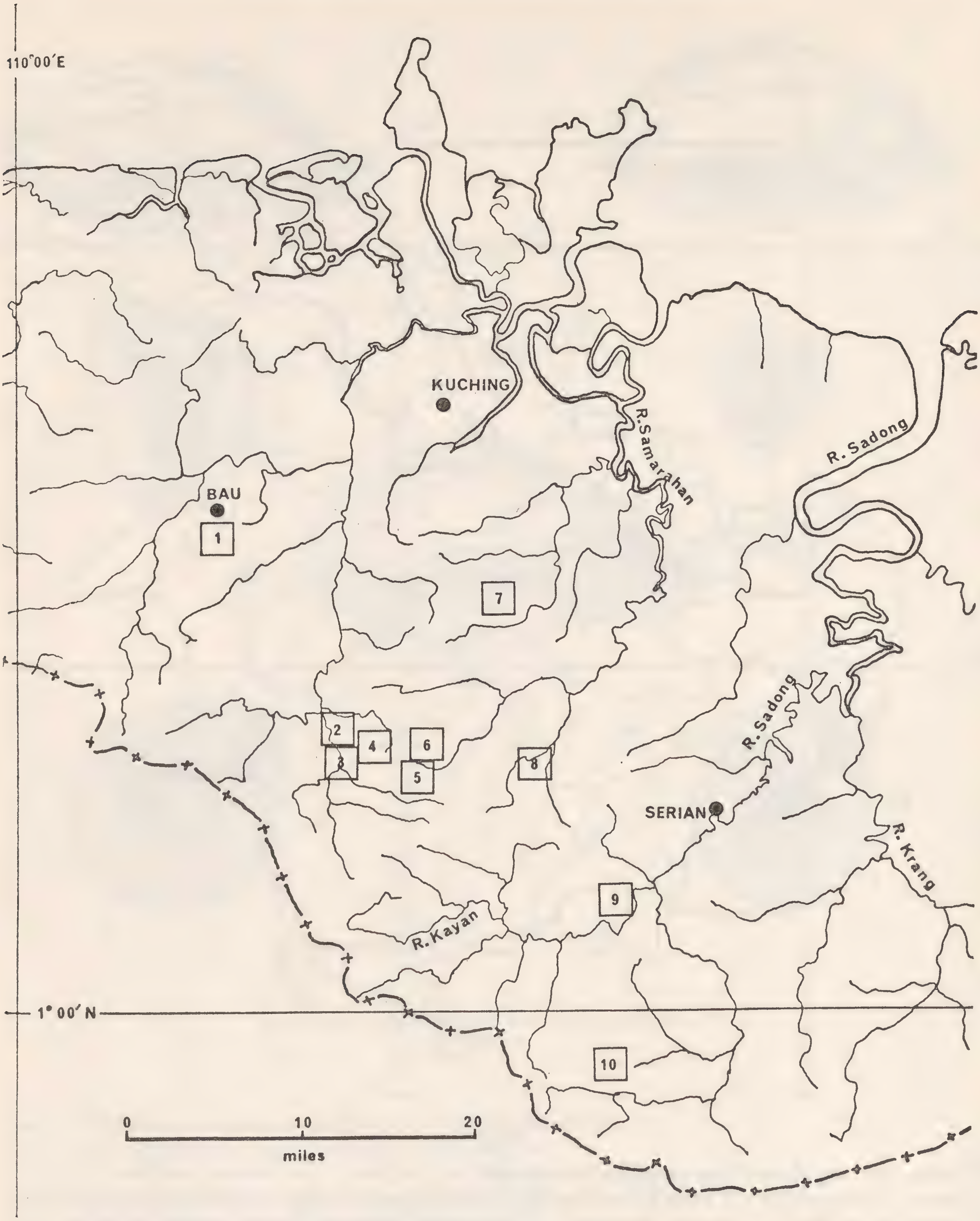
FIG. 1. *Platycochlium sarawakense* Laidlaw, holotype, apertural view.
2. *Platycochlium saulae* n.sp., holotype, apertural view.
3. *Platycochlium barnaclei* n.sp., holotype, apertural view.
4. *Sinoennea laidlawi* n.sp., holotype, apertural details.
5. *Sinoennea bongi* n.sp., holotype, apertural details.
6. *Diaphera wilfordi* n.sp., holotype, apertural details.
7. *Diaphera porrecta* (von Martens), holotype, apertural details.



MAP 1

Borneo, showing all localities mentioned in the text.

Sarawak Gunong Kapor, 3 miles SW of Bau [1]; Gunong Kawa, 2 miles S of Bau [1]; Gunong Doya, 2 miles SW of Bau [1]; Bra-ang Mountain, 22 miles S of Kuching [2]; hill 1 mile NE of Pankalan Ampat, 25 miles S of Kuching [3]; Wah Mountain, 23 miles S of Kuching [4]; Saak Mountain, 1 mile W of Begu, 24 miles S of Kuching [5]; Gayu Mountain, 23 miles S of Kuching [6]; 2 small hills by side of Simanggang Road, 18½ and 21 miles SSE of Kuching [7]; hill 8 miles SW of Serian [9]; Gunong Selabor, about 16 miles SSW of Serian [10]; Bukit Sarang, 20 miles SE of Tatau [11], *Sabah* near Keningau [12]; limestone ridge in the Tabin Valley (a tributary of the lower Segama), about 55 miles SE of Sandakan [13]. *Kalimantan* 'Berge Radjang Klewang, Südost Borneo' (exact location not known) [14].



MAP 2

Region south of Kuching, Sarawak, showing some of the localities [1–10] mentioned in the text. See legend to Map 1 for details of localities.

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SOME ASPECTS OF THE BEHAVIOUR OF PEST SPECIES OF SLUGS

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(*Read before the Society, 21 March 1970*)

INTRODUCTION

During routine work carried out to reveal other aspects of the biology of pest species of slugs, the opportunity arose to make certain brief observations of a comparative nature on the behaviour of *Agriolimax reticulatus* (Müller), *Milax budapestensis* (Hazay) and *Arion hortensis* Férussac. Lack of published information on the behaviour of slugs makes it worthwhile to place this work on record, although a more thorough study is still desirable, the subject having a bearing on the concentration of application of baits (Hunter & Symonds, 1969).

OBSERVATIONS

1. *Mucus Secretion*

Transverse sections cut from material preserved in Susa's Fixative and stained with Mallory's Triple stain showed that the cubical epithelical cells were pierced by very large mucus secreting cells staining blue, and the numbers and size of these appeared to be characteristic of the species. Other secreting cells which stained red could possibly be responsible for secreting a noxious fluid.

The three species of slugs were killed by immersion in 70% alcohol after being kept in uniform conditions. Taking 10 individuals of each species, the quantity of slime exuded as the animals died was measured and the results are given in Table 1.

TABLE 1
Variation in Slime Production

	Agriolimax reticulatus		*Arion hortensis*		*Milax budapestensis*	
	Wt. Slug	Wt. Slime	Wt. Slug	Wt. Slime	Wt. Slug	Wt. Slime
	535 mg.	16 mg.	295 mg.	negligible	520 mg.	2 mg.
	465	6	245	2 mg.	570	negligible
	590	38	473	<2	596	12
	360	5	410	7	526	4
	520	11	372	4	456	22
	620	28	184	3	404	4
	368	50	422	2	688	2
	420	56	290	0	697	0
	457	56	280	0	560	2
	393	50	368	0	402	2
Mean	473	31·6	334	2·0	542	5·0

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Agriolimax reticulatus was found to exude more slime than did the other two species.

2. *Relative Activity*

A simple apparatus was used to measure the relative activity of the three species of slugs.

A shallow tank contained a solution of a slug repellent, aluminium potassium sulphate (concentration 25 g. per litre), which came to within 5 mm. of the surface of a central platform (Figure 1). The edge of the platform had a strip of gummed masking tape round its edge, so that about 3 mm. projected above the level of the platform and the solution. This served to prevent flooding of the platform and also minimised the area over which the slug could move without leaving a trace of its path. Light was excluded with a cloth-covered frame 50 cm. high. Projecting down from the roof of the frame was a vertical rod which had an 8 cm. nail driven into its base. This prevented the platform from floating, without giving the slug a means of moving upwards off the platform.

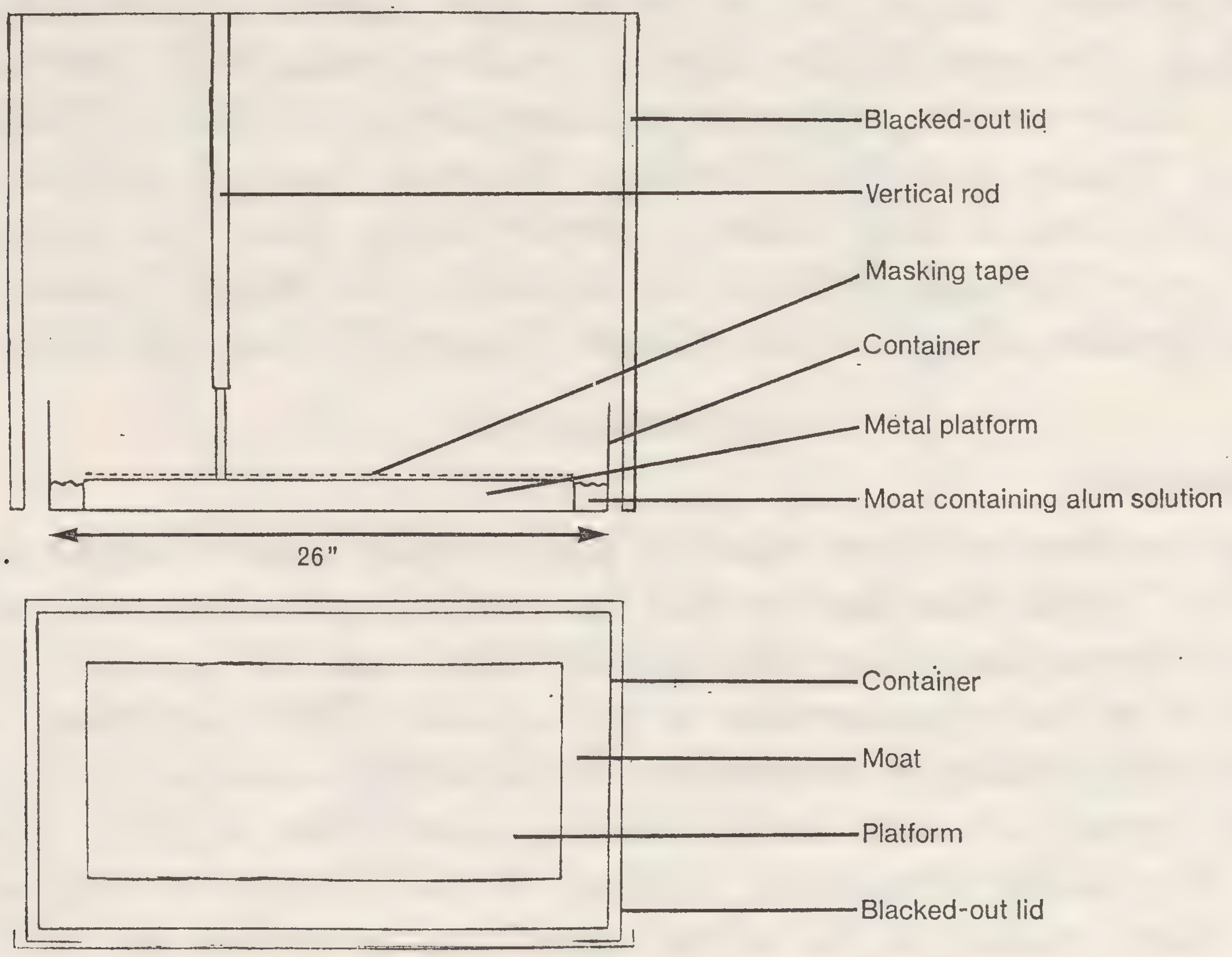

Fig. 1.

To set up an experiment a sprinkling of kaolin was shaken on to the clean surface of the platform, and this was then moistened evenly with a very fine spray of water. Sliced carrot was placed in the centre of the platform so as to provide some incentive for movement and 2 slugs were placed one towards each end of the platform, thus enabling two records to be obtained over one time period. Three sets of the apparatus were used simultaneously to ensure that the conditions were as uniform as possible. The slugs and the inside of each box were lightly sprayed with water at the beginning of the experiment to provide some measure of humidity.

Measurements were made of the distances covered, a good track being left in the thin kaolin layer. In the records tabulated below the total distance covered for each pair of individuals was added together and the average distance calculated for a total of 40 records made for each species.

It is seen that from the table that *Agriolimax reticulatus* was twice as active as *Arion hortensis*, and that *Milax budapestensis* was a little less active than *Arion hortensis* (Table 2).

TABLE 2

Relative activity of Agriolimax reticulatus, Arion hortensis and Milax budapestensis in the presence of food

Temp.	Hours	*Agriolimax reticulatus* (2 individuals)	*Arion hortensis* (2 individuals)	*Milax budapestensis* (2 individuals)
66°	6	165 cm.	130 cm.	— cm.
62	5	167	78	33
60	6	125	60	18
66	5	—	148	80
62	6	235	55	100
66	6	123	—	58
62	6	215	—	30
68	6	158	165	43
62–64	6	193	183	150
64	6	403	—	105
60	5	177·5	65	67·5
60	8	220	165	167·5
60	3	30	85	212·5
60	5	70	132·5	202·5
62	6	402·5	205	95
60	5	480	67·5	105
60	6	167·5	150	—
64	6	175	47	162·5
62	6	395	187·5	—
60	6	115	137·5	—
Mean for 1 individual in 5¾ hours.		100	51	41

The same apparatus and method were used to obtain a further set of 20 recordings when no food was provided, and only a slight reduction in the average distance covered took place, compared with the first set of results. The absence of food did not especially decrease the activity of the slugs and again *Agriolimax reticulatus* was seen to be twice as active as the other two species (Table 3).

TABLE 3

RELATIVE MOVEMENT OF AGRIOLIMAX RETICULATUS, ARION HORTENSIS AND MILAX BUDAPESTENSIS IN THE ABSENCE OF FOOD

Temp.	Hours	*Agriolimax reticulatus* (2 individuals)	*Arion hortensis* (2 individuals)	*Milax budapestensis* (2 individuals)
60°	6	140 cm.	120 cm.	— cm.
64	6	257·5	82·5	127·5
60	6	280	175	—
60	6	145	45	15
60	5	52·5	132·5	—
60–68	6	270	47·5	200
60–64	6	215	55	165
60	6	75	127·5	195
58–60	6	182·5	17·5	—
66–68	5	90	95	13
Mean for 1 individual for 5¾ hours.		85 cm.	45 cm.	35 cm.

It was characteristic of the slug movement in all these experiments in the dark that the animals seldom moved far in a straight line, but in circles of varying diameters.

Movement on Approach to Food Bait

Using the same apparatus the method was modified to observe the movement on approach to metaldehyde bran bait. A small pellet of bait was placed towards one end of the platform and the slug was placed at random on an imaginary arc at the opposite end. It became evident from this last experiment that as the slugs approached the bait there was no increase in circling or lateral movements once the animals were near enough perhaps to sense the food.

The Effect of Surface Texture on Movement

Medium-sized *Agriolimax reticulatus*, *Milax budapestensis* and *Arion hortensis* were allowed to move over three types of surface, namely polythene sprayed with fine droplets of water, which could be thought to simulate the smooth surface of leaves; moist sand; and moistened loam passed through a 1 cm. gauge sieve.

The average rate of movement on these three types of surface shows that the rate of movement is much reduced over the angular surface of the loam (Table 4).

TABLE 4

MOVEMENT OVER SURFACES OF DIFFERING TEXTURES

	MEAN RATE OF MOVEMENT, CM./MINUTE		
	POLYTHENE	SAND	LOAM
A. reticulatus	11·5	10	5
A. hortensis	3·8	4·5	2·5
M. budapestensis	4	5	3·5

A graph of the rate of movement (Figure 2) of the slugs over the polythene surface shows that, although *A. reticulatus* can move more quickly than *A. hortensis* or *M. budapestensis*, it does not appear to be able to maintain the high speed for long.

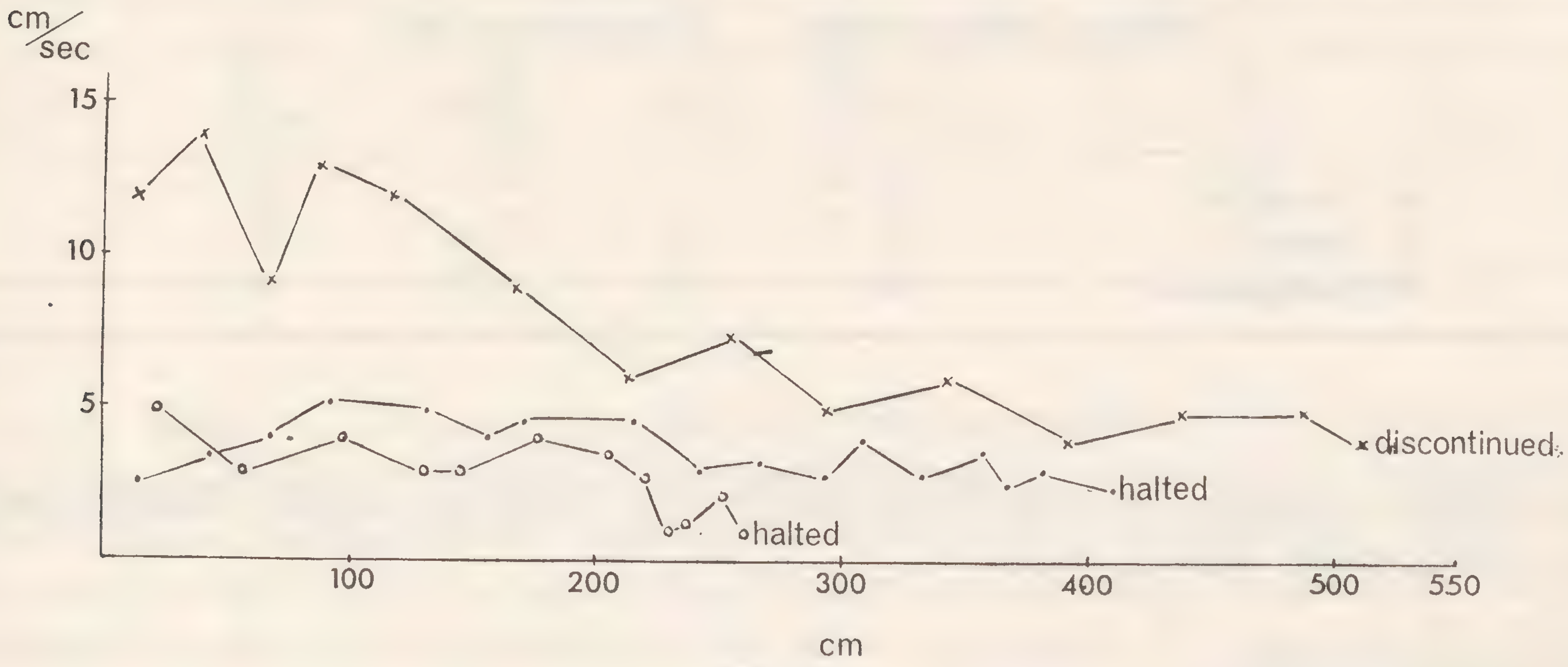

Fig. 2.

Movement of Young

Young slugs of between 1 and 2 cm. in length when fully extended can be very active. The graph Figure 3 shows the rates of movement of a young individual of *A. reticulatus*, *M. budapestensis* and *A. hortensis*. This brief recording shows how well adapted the young are for finding food, and after the food, shelter.

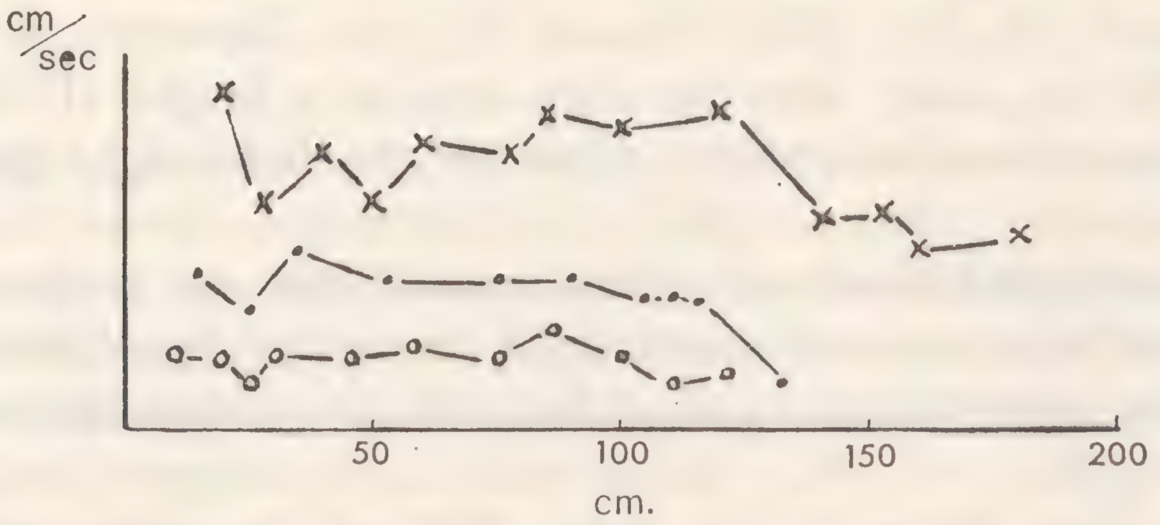

Fig. 3.

Initiation of Movement

Three individuals of *A. reticulatus, A hortensis* and *M. budapestensis* were sprayed lightly with water and placed on moist sand at right angles to the incident light. A darkened area was provided diameterically opposite to the incident light. The majority of the animals moved away towards the darkened area, but a great difference was noticed in the speed at which *Agriolimax* sought shadow compared with the reactions of the other two species. The results are given in Table 5. The majority of *Agriolimax reticulatus* moved away from the light within a minute, whereas the majority of *A. hortensis* and *M. budapestensis* were much more slow to react.

TABLE 5

INITIATION OF MOVEMENT

	Minutes before moving	(Temperature 66°)		
	0–1	2–5	6–20	>20
A. reticulatus	13	1	1	0
A. hortensis	2	3	8	2
M. budapestensis	4	4	3	4

Discovery of Shelter

At dawn slugs seek shelter away from the light (Duval, in proc.; Newell, 1968), which usually means also the discovery of a relatively humid place in which to spend the hours of daylight. Investigation was made to discover what a slug regards as a suitable crevice. Only *A. reticulatus* and *A. hortensis* were available for this work.

Using cork borers, holes approximately 2 cm. apart and 3–4 cm. deep were made in a block of stiff gault clay. Separate experiments tested the reaction of the slugs to holes of 0·4, 0·5, 0·75, 1·0 and 1·5 cm. diameter. A 25 watt light bulb was placed 60 cm. away from the clay area, at a height of 20 cm. and the clay area was enclosed on 3 sides by a dark box, so that a light gradient existed to induce movement.

Slugs were released and observed as they moved over the surface of the moist clay. For each size of hole a record was made of the percentage of holes ignored, the percentage of holes inspected and passed by, and the percentage of holes which was entered.

It can be seen from Table 6 that about 65% of the holes were ignored at

TABLE 6

ENTRY INTO HOLES OF KNOWN DIAMETER

Agriolimax reticulatus

DIAM. IN CM.	% HOLES IGNORED	% HOLES INSPECTED AND PASSED BY	% HOLES ENTERED IN WHICH SLUGS REMAINED
0·4	67	27	6·7
0·5	57·5	27·5	15·0
0·75	50	5·5	44·5
1·0	42	5	53
1·5	33	—	66

Arion hortensis

DIAM. IN CM.	% HOLES IGNORED	% HOLES INSPECTED AND PASSED BY	% HOLES ENTERED IN WHICH SLUGS REMAINED
0·4	65	30	5
0·5	48	20	32
0·75	35	6	59
1·0	52	5	43
1·5	31	6	63

0·4 cm. diameter, but when the diameter was increased to 0·75 cm. about half the holes were entered. Further increases of diameter of the holes continued to lead to some increase in the number of holes to become occupied. Holes with an entrance and shadow smaller than the area which would comfortably accommodate the slug were ignored and no time was wasted in searching for shelter by hesitation over entry to unsuitable places. Holes which were inspected but not entered were usually only briefly investigated. The holes of a 0·75 diameter were inspected by the slug putting its head into the opening with tentacles fully extended.

Arion hortensis showed no markedly greater tendency than *Agriolimax reticulatus* to investigate small openings despite its known more subterranean mode of life.

Thigmotaxis

It was thought possible that slugs might possess some measure of a thigmotactic response which would augment their ability to take over. Simple experiments were carried out in a moist atmosphere in the dark using the curved surface of flower pot crocks and damp corrugated paper to try to obtain an answer to this question. Although the results cannot be said to be conclusive, such evidence as was obtained suggests that thigmotaxis plays an unimportant part, or is entirely absent.

CONCLUSIONS

A. reticulatus secretes more mucus than *A. hortensis* or *M. budapestensis* and this can be correlated with the observed fact that *A. reticulatus* is the most active and most fast moving of the three species.

Movement over a moist smooth surface is more rapid than over an uneven suface.

A reticulatus reacts more quickly than *A. hortensis* and *M. budapestensis* in the avoidance of light, which is surprising perhaps as the two latter species are known to have a more subterranean habit. Further, in spite of the latter habit, *A. hortensis* was not shown to be more prone to investigate small apertures for shelter than *A. reticulatus*.

Thigmotaxis has not been shown to be important as a secondary factor in finding shelter.

ACKNOWLEDGMENTS

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NUMBERS OF SHELLS

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(*Read before the Society, 18 November 1967*)

Mrs. N. F. McMillan (1954) commences "A Note on the Numbers of Shells" with these words, "So little is known of the number of snails in any area". The present author (1948) did give some indication of numbers which can occur, having counted 2,795 shells in a gallon of flood debris from the River Colne at Aldenham, Hertfordshire, gathered after floods in 1946, and a further 1,672 in a similar amount of debris taken the following year. Numerically this was of some interest, but in this instance the numbers of shells gave a distorted picture in that they were nearly all dead shells and may not have come from the immediate locality. This is further emphasised by the finding in October 1967 of *Oxychilus draparnaldi* (Beck), *Planorbis planorbis* (Linné) and *Bithynia tentaculata* (Linné) in spring tidal debris on the River Alde, Aldeburgh, Suffolk, together with *Littorina*, *Hydrobia* and *Cardium*. The following account gives a more accurate picture of the numbers of snails occurring in a prescribed habitat.

In July and September 1964, Dr. L. V. Knutson, of Cornell University, and Mr. J. W. Stephenson, of Rothamstead Experimental Station, paid two visits to Tenby, Pembrokeshire, in search of Sciomyzid flies, whose larvae are predatory or parasitic on snails. In connection with this quest they collected large numbers of snails, which were passed to the author for identification. The results are set out below.

Site

The sand dunes at Tenby extend in a south-westerly direction from the town. The widest part is nearest to it, and most of this is covered with an extensive growth of Sea Buckthorn, planted some thirty years ago. This is followed by an area of loose sand with patches of marram grass in which *Helix aspersa* Müller and *Helix nemoralis* Linné may be found. The character of the dunes changes again to a narrow strip well grown with plants. It was in this strip that the flies and snails were collected.

The development of a rich flora and fauna is based in part on the configuration of this part of the dunes providing a favourable environment. On the landward side is a high bank separating the dunes from the golf course. The ground then slopes down to a low sandy bank grown mainly with marram grass, beyond which is the sea-shore. There are two sandy paths, bare of vegetation, at the top and bottom of the slope, and marked D and E on the section shown in Fig. 1.

The bank on the north-western side provides some shelter from the prevailing south-westerly winds, and the seaward bank may give a little shelter from the less frequent easterlies.

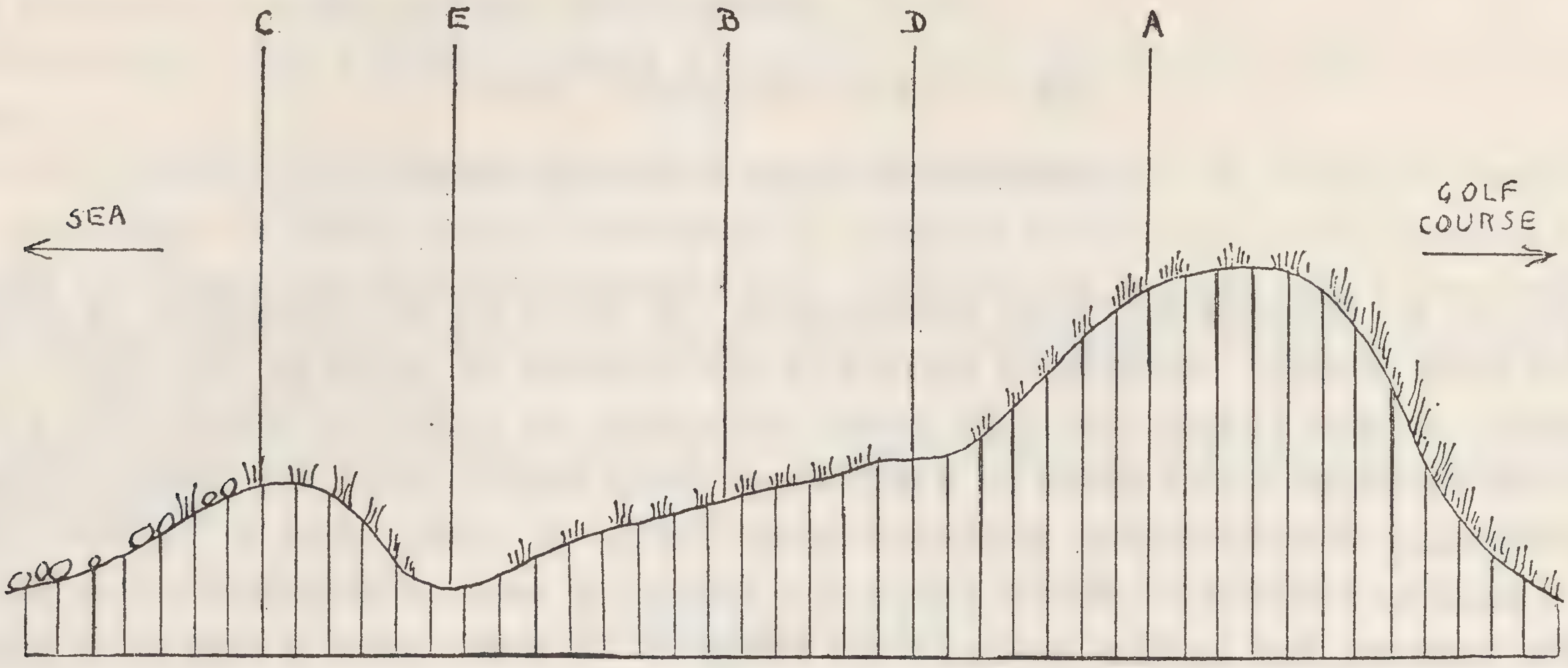

Fig. 1.

Methods

The area studied was a rectangle 300 by 20 metres along this sand dune area. The snails were sampled twice: on 6 and 7 July, and on 10 and 11 September 1964. In July, 25 samples were taken. Each consisted of all snails visible on the substrate and on vegetation contained in two quadrats (20 by 10 cm.) placed side by side at the sampling point. Eight samples were taken from the top of the dune, ten from the middle and seven from the bottom (Fig. 1, A, B and C).

In September snails were collected from the substrate as well as from the surface and vegetation. The quadrat shown in Fig. 2 was used to take ten samples (20 by 10 by 6 cm.) spaced equidistantly along the centre line of the plot (Fig. 1, B). The quadrat was pushed into the substrate as far as the flanges, that is, 6 cm. deep, and the "trowel" inserted from one end. The whole sample was lifted and placed in a polythene bag. The snails were recovered by passing the contents of each bag over a 2 mm. sieve.

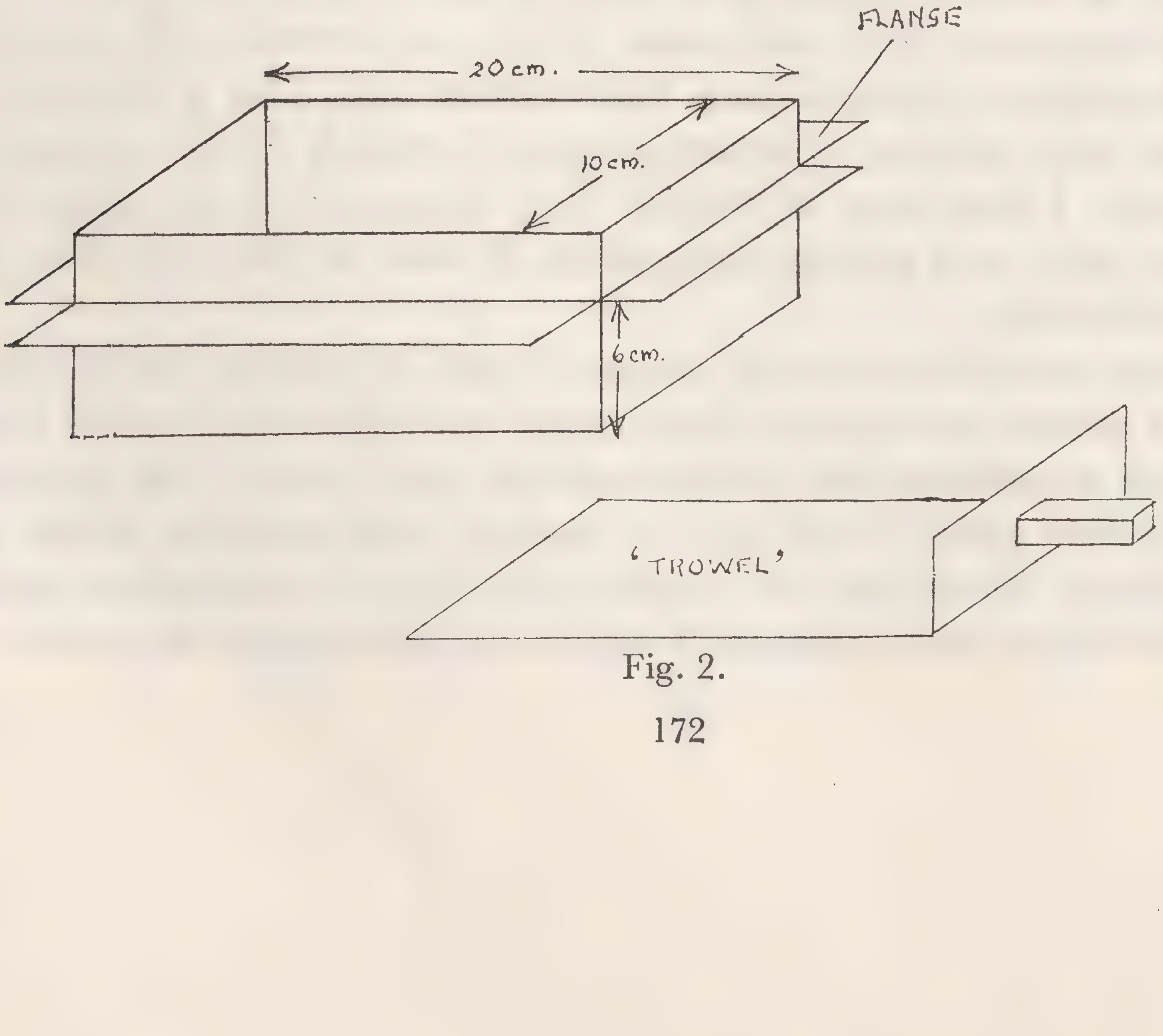

Fig. 2.

Specimens of all angiosperms growing within a one metre radius of each quadrat on line B were collected in July, and their frequency was estimated.

RESULTS AND DISCUSSION

(a) *Plants*

The results of the botanical survey are set out in Table 1, in which the plants are listed in order of frequency.

TABLE 1

The Frequency of Angiosperms Expressed on the Scale
1 = Scarce to 5 = Abundant

Sampling Station	Nature of Mat	*Asperula cynanchica*	*Lotus corniculatus*	*Senecio jacobaea*	*Eryngium maritimum*	*Erica cinerea*	*Galium verum*	*Leontodon hispidus*	*Onoris repens*	*Ammophila arenaria*	*Hieracium umbellatum*	*Anthyllis vulneraria*	*Rhinanthus* sp.
1	Grass + Moss	1	1				4		5	2			
2	Grass							1			3	4	5
3	Grass			1	1						2	5	
4	Grass + Moss						1	1		2	1	4	4
5	Grass + Moss					2		1			3	4	5
6	Grass				1		1	1			3	4	4
7	Grass							1	3	1	3		4
8	Grass						1				3		4
9	Grass							2		3	2		4
10	Grass							1	2	2	1		4
Total		1	1	1	2	2	7	8	10	11	21	21	34

On the more recently colonised seaward side of the site, clumps of growing plants were separated by areas of exposed sand. On the landward side apart from the two paths, there was little exposed sand, but between the upright plants there was a mat consisting of grasses and scattered areas of moss. This mat is an important feature of the habitat because it provides excellent cover for the immature snails. Even at mid-day the soil beneath the mat was cool and moist, and most of the immature snails were found there. Early and late in the day, large numbers of snails were seen moving up or over the vegetation.

All the plants tend to be erect in habit, and only occasionally procumbent or decumbent. They were fairly widely spaced and there was no well-defined vegetation canopy. Seasonal changes in the amount of vegetation certainly occur, but at all times of the year the site would be described as "exposed". There would be little shade for the snails.

(b) *Mollusca*

The number of snails collected in July was 1,467, an average of 58·7 per quadrat. The total was made up as follows:

Line A	8 quadrats	374 shells	Average 46·8
Line B	10 quadrats	783 shells	Average 78·3
Line C	7 quadrats	310 shells	Average 44·3

The majority of shells were adult, and 12 species were represented.

The September samples from ten quadrats along Line B produced 2,170 shells, an average of 217. There were 15 species. A large proportion of the shells were "dead" and, of the 2,170, 1,530 were juveniles under 3 mm. in size.

TABLE 2

	July				September
	A	B	C	Total	Total
Cochlicopa lubricella (Stab.)	—	—	—	—	23
Vertigo pygmaea (Drap.)	—	—	—	—	7
Pupilla muscorum (L.)	1	—	—	1	33
Lauria cylindracea (da Costa)	—	5	—	5	25
Vallonia pulchella (Müller)	—	—	—	—	10
Theba pisana (Müller)	2	2	26	30	4
Cepaea nemoralis (L.)	—	1	—	1	—
Hygromia hispida (L.)	—	1	4	5	—
Monacha granulata (Alder)	—	—	3	3	2
Helicella caperata (Mont.)	52	120	26	198	37
Helicella virgata (da C.)	117	344	80	541	121
Helicella itala (L.)	11	—	—	11	7
Cochlicella acuta (Müller)	193	304	170	667	1538
Punctum pygmaeum (Drap.)	—	—	—	—	13
Euconulus fulvus (Müller)	—	—	—	—	3
Oxychilus alliarius (Miller)	—	2	—	2	—
Retinella nitidula (Drap.)	—	2	1	3	2
Vitrina pellucida (Müller)	—	—	—	—	3
Sundry juveniles	—	—	—	—	342
Total	374	783	310	1467	2170

The figures show that, in the July samples, Line B covered the most favourable habitat. A comparison of the July and September figures for Line B shows that, had the quadrats been of equal size, the relative numbers would have been, July 783; September 4340. The increase is accounted for by the addition of the shells in the substrate. This very large addition is probably due in part to the hatching after July of the eggs of *Cochlicella acuta*. Of the 1,538 shells of this species, 1,188 were juveniles under 3 mm. In any attempt to assess the snail population of this type of habitat, a sampling technique which takes account of the snails in the substrate should be used.

The finding of snails in these numbers makes it tempting to estimate the overall population of the area. This temptation will be resisted, but it is certain that the total number of shells, dead and alive, must run into millions.

It will be noted that six of the September species, *Cochlicopa lubricella*, *Vertigo pygmaea*, *Vallonia puchella*, *Punctum pygmaeum*, *Euconulus fulvus* and *Vitrina pellucida*, are missing from the July list. Of these *Vertigo Vallonia*, *Punctum* and *Euconulus* are very small, probably lived in the mat, and so were overlooked. This may also be true of *Cochlicopa*, and also of *Pupilla muscorum* (1) and *Lauria cylindracea* (5), which showed considerable discrepancy from the September figures. *Vitrina* is active and breeds in winter.

Of the July species missing in September, *Cepaea nemoralis* was represented by one juvenile. In 1960 and 1963 the author found several adults in this part of the dunes, but they were widely scattered and could easily have missed the quadrats. The five *Hygromia hispida* were found in three quadrats and the two *Oxychilus alliarius* were in one. These two species appear to be scarce in the area.

The high incidence of the *Helicella* species was to be expected. All are xerophilous and obligatory calcicoles; the area is generally dry and is highly calcareous. *Helicella caperata* was fairly evenly distributed throughout the quadrats, both in July and September. About 30% were the var. *ornata*, the rest varied a good deal in colour. *Helicella virgata* occurred in all but one of the July quadrats and all in September, varying in numbers from 3 to 83 in the former and from 1 to 22 in the latter. Of all shells 66% were banded, 26% were var. *lutescens*, 7% var. *albicans* and there were four var. *albida*. *Helicella itala* was found only in Line A in July, in samples 1 to 5, and in Line B, sample 1 in September. This suggests that the species is confined to the northern end of the site.

Cochlicella acuta was the most abundant snail in each count; 45·3% in July and 70·8% in September. In July only living snails were taken, and the 667 included few very small shells. In September, of 1,538 shells only 150 (9·8%) had reached maturity, 200 (13%) were juveniles over 3 mm. in height and 1,188 (77·2%) were juveniles under 3 mm. These shells consisted of from two to four whorls. The vast majority were dead shells, so that it would seem that something over 60% of *Cochlicella* died very shortly after hatching.

Little comment is needed on the other species. *Theba pisana* is specially associated with Tenby. The presence of *Monacha granulata* confirms that in the west this species can and does inhabit dry places (Stratton, 1965) though in the east of England it lives only in damp places. The 342 "Sundry juveniles" were all helicoid shells, all under 3 mm. and virtually impossible to name. Most of them were dead shells. It would seem that the high infant mortality is maintained throughout the molluscan fauna of the site.

Thanks are due to Dr. Knutson and Mr. Stephenson, who did the hard work in collecting the shells.

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PISIDIUM LILLJEBORGII CLESSIN, IN THE RIVER TEIFI, WEST WALES

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(*Read before the Society, 15 November 1969*)

Pisidium lilljeborgii has a northern and western distribution in the British Isles. It is found in "clean gritty sand or silt, not in mud,* and characteristically in mountain lakes both at high altitudes and near sea level, hence mostly in soft water" (Boycott, 1936: 136). According to Ellis (1962: 56) it occurs "occasionally in adjacent streams and canals". I cannot trace a record of its occurrence in a stream, and it seems to have been recorded from only one canal (the Shropshire Union Canal near Llangollen) (Boycott and Oldham, 1936: 223).

In Wales it has been recorded from the counties of Glamorgan, Montgomery, Merioneth, Caernarvon, Denbigh and Anglesey (Ellis, 1951: 218). With the exception of the single Glamorgan locality (Llyn Fach at 1,450 feet on Craig-y-llyn) this gives the impression that *P. lilljeborgii* is not found in the entire southern half of the principality below a line drawn from Barmouth on the west to Shrewsbury on the east.† In an attempt to extend our knowledge of its range (and that of other species of *Pisidium*) in Wales I looked for it, in 1969, in "likely places" in the southern half. The following comment by Oldham (1938) offered little encouragement: "No suitable locus for *lilljeborgii* in Pembroke is known to me, and in Brecon, Radnor, and Carmarthen lakes and mountain tarns are less numerous than farther north, whilst such as there are have often been converted into reservoirs, a state of things than is even more prevalent in Cardigan. This implies violent and frequent changes in water-level, a condition repugnant to *lilljeborgii* and some other Pisidia. I have searched for *lilljeborgii* in all these southern counties without success, but its occurrence in Glamorgan suggests that eventually it will be found in tarns that have retained their natural state elsewhere in South Wales". Numerous mountain lakes and smaller bodies of water below and above 1,000 feet were examined in the counties of Monmouth, Glamorgan, Brecon, Carmarthen and Cardigan and *P. lilljeborgii* was not found in any of them although several seemed to have conditions ideal for it. One or more *Pisidium* species commonly found with it, such as *P. casertanum* (Poli), *P. hibernicum* Westerlund, *P. milium* Held, *P. nitidum* Jenyns, and *P. subtruncatum* Malm, occurred in nearly every locality (the exceptions being reservoirs or polluted waters). Some attention was given to other, less elevated localities. Surprisingly, it was in two of these that *P. lilljeborgii* finally turned up.

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* 'It is not clear what distinction he [Boycott] makes between silt and mud. In Windermere *P. lilljeborgii* is the only species to occur more frequently on sandy bottoms with less than 10% organic matter than on bottoms with a higher value than this, but it is also recorded from localities with as much as 45% organic matter in the soil' (Macan, 1950:143–4).

† The nearest locality to Llyn Fach, Glamorgan, was said to be Llyn Du, about 70 miles to the north-east, near Meifod, Montgomery (Oldham, 1938). On 12 October 1969, I found the species in Glynbrochan Pool, a lake at 1050 feet near Llangurig, Montgomery. This locality is about 50 miles due north of Llyn Fach.

Previous experience had shown that few molluscan species occur in the rapidly flowing boulder-strewn rivers and streams so characteristic of much of Wales. Where a little silt and mud has accumulated *P. casertanum*, *P. hibernicum*, *P. milium*, *P. nitidum* and *P. subtruncatum* may occur, but seldom more than three of these together. The River Teifi proved to be different. This river, originating several miles north of Tregaron, flows almost the length of Cardigan and separates that county from Carmarthen (and, near its mouth, from Pembroke). Wide and relatively shallow in places, it is narrow and deep in its lower reaches and has spectacular falls at Cenarth; it is exceptionally clean and is famous for its salmon. In 1969—a remarkably dry year—it was shallower than it had been for a long time; this facilitated *Pisidium* collecting. At Llanbyther, Carmarthen, on 23 June 1969, I scooped in the fine grey mud (not analysed but apparently full of organic matter) which had accumulated at a quiet bend in the river. The species of *Pisidium* present were *P. casertanum*, *P. hibernicum*, *P. lilljeborgii*, *P. nitidum* and *P. subtruncatum*. With a single exception (mentioned below) *P. lilljeborgii* has not been recorded from any river in the whole Palaearctic region. In North America, where the species is scarce, it occurs in "mud or ooze bottom in creeks and rivers, but mostly in ponds and small lakes" (Herrington, 1962: 45). Its occurrence in the River Teifi, therefore, was puzzling and deserved further investigation. *P. lilljeborgii* had not been found anywhere near Llanybyther (equidistant from Llyn Fach and Glynbrochan Pool, about 35 miles from each) and this find suggested that it might be found elsewhere in the river. To see if it had established itself at other places several stations along the river's length were sampled (selected on the basis of accessibility only). These are indicated on the map (Fig. 1). The accompanying Table presents the results of the sampling.

The Table shows that *P. lilljeborgii* was found in the river where it flows through Tregaron Bog, and in a marsh drain close by. Tregaron Bog, therefore, could be the parent source of the population living at Llanybyther. It was unusual to find the species in a river; almost incredible to find it in a peaty bog. A summary of the different kinds of habitats frequented by *Pisidium*, based on Oldham's field work, has been published by Boycott (1936: 137). It shows that *P. lilljeborgii* occurred in 58 mountain lakes and tarns above or below 1,000 feet and nowhere else (apart from two occurrences, both in the Shropshire Union Canal and probably in the same place). It shows also that each of the *Pisidium* species found with it in the Teifi has been recorded from other rivers; conversely each has also been found living in other habitats with *P. lilljeborgii*.

The occurrence of *P. lilljeborgii* several miles downstream from the bog, which is traversed and drained by the Teifi, was not so surprising after all; but its presence in the bog itself was still an unsolved problem. Tregaron Bog is really a group of three raised bogs occupying a large area in the upper Teifi valley. Raised bogs are of peculiar interest, particularly to botanists, because "they appear to develop in glaciated valleys from the nucleus of a late-glacial lake which has undergone progressive filling by lake and fen deposits before obliteration of open water allowed the establishment of the raised bog Sphagneta" (Godwin and Conway, 1939: 314). When it is realized that these three raised bogs are very extensive and more than 500 feet above sea level, that they occupy the sites of late-glacial lakes, and that they are well within the known range of *P. lilljeborgii*, it is a fair assumption that *P. lilljeborgii* lived in the original lakes and has been able to survive ther transition to raised bogs.*

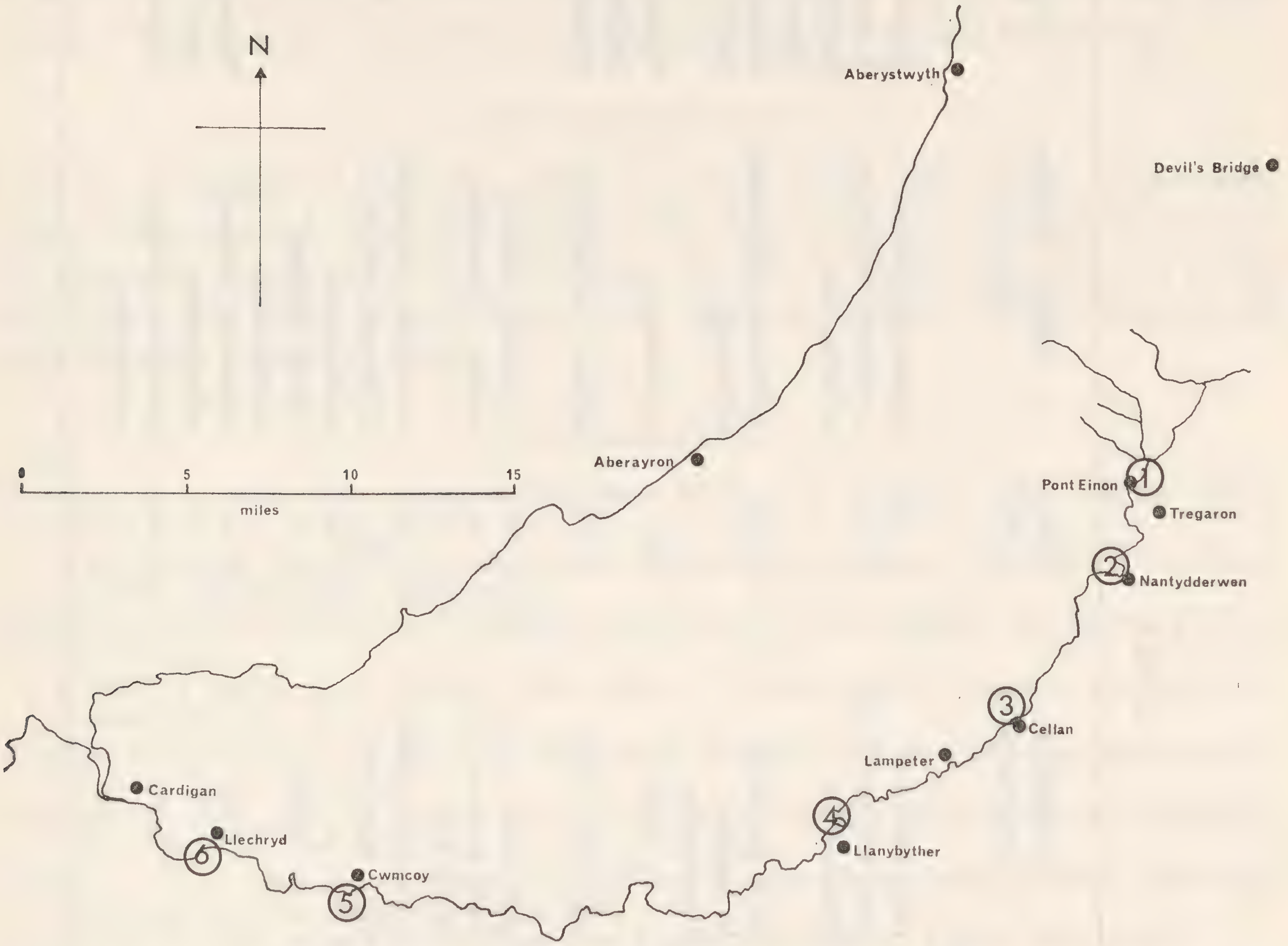

FIG. 1. The River Teifi, West Wales, showing the six stations sampled for *Pisidium* in 1969. For the subdivisions of Stations 1 and 4 refer to the accompanying Table. *Pisidium lilljeborgii* was found at both of these stations.

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* This may explain the presence of *P. lilljeborgii* in the Fen (adjacent to Malham Tarn) in Yorkshire (Stratton, 1956). There, in muddy runnels beneath the vegetation (consisting of *Carex* and *Sphagnum*), *P. lilljeborgii* lives with six other species of *Pisidium*. The Fen is part of Malham Tarn Moss which is almost entirely acid raised bog. It is possible, however, that the Fen population is derived from that living in Malham Tarn itself.

TABLE

		Station	Grid Reference	Nature of Substrate	Date (1969)	Pisidium Species Present	Other Molluscs Present
1.		Pont Einon, Tregaron Bog.					
	(*a*)	marsh drain	22673614	oozy red mud	9. ix.	*lilljeborgii, nitidum*	*Sphaerium corneum* (L.)
	(*b*)	river adjacent to 1*a*.	22673614	oozy red mud with *Potamogeton*	9. ix.	*casertanum, hibernicum, subtrumcatum*	*Lymnaea truncatula* (Müller,) *Sphaerium corneum*
	(*c*)	¼ mile SW of 1*b*.	22671613	oozy red mud in tangled *Potamogeton*	20. ix.	*casertanum, hibernicum, lilljeborgii*	*Lymnaea pereger* (Müller)
2.		Nantydderwen, S of Tregaron.	22665570	mud	9. ix.	*casertanum*	*Planorbis albus* (Müller)
3.		Cellan.	22616498	mud and weed	9. ix.	*nitidum, subtruncatum*	*Planorbis albus*
4.		Llanybyther.					
	(*a*)	river bank.	2252–44–	grey mud	8. ix.	*hibernicum, nitidum*	—
	(*b*)	50 yards from 4*a*.	2252–44–	mud at roots of *Iris* sp.	8. ix.	*milium, subtruncatum*	—
	(*c*)	50 yards from 4*b*.	2252–44–	grey mud where ditch empties	23. ix. & 8. ix.	*casertanum, hibernicum, lilljeborgii, nitidum, subtruncatum*	—
	(*d*)	100 yards from 4*c*.	2252–44–	mud	8. ix.	*milium, nitidum, subtruncatum*	—
5.		½ mile S of Cwmcoy.	22285414	mud	10. ix.	*hibernicum, nitidum, subtruncatum*	*Potamopyrgus jenkinsi* (Smith)
6.		Llechrydd.	22218436	mud	11. ix.	*casertanum, nitidum, subtruncatum*	*Potamopyrgus jenkinsi*

The species is common in many mountain lakes between 5,500 and 7,500 feet in the Pyrénées Orientales; but one of its localities there is a marsh through which runs the River Têt. It is clear, however, that this marsh population originated from the nearby Lac des Bouillouses (Kuiper, 1964, and *in litt.* 10.x.1969). Consequently, the presence of *P. lilljeborgii* in the raised bog/river complex at Tregaron, and of a presumably derivative population in the River Teifi, about 15 miles downstream at Llanybyther, is uniquely interesting.

ACKNOWLEDGMENTS

J. G. J. Kuiper of Paris has given me much useful information, particularly about his own work on *P. lilljeborgii* in the montane areas of southern Europe. By detecting the species in my gatherings Dr. M. P. Kerney gave me the excuse for writing this paper (as well as an object lesson in *Pisidium* identification). I am very grateful to both of them.

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OBITUARY

FRITZ HAAS

Fritz Haas died on 26 December 1969 in Hollywood, Florida, after being in hospital for several weeks. He is survived by his wife Helene, his son Ernest and his daughter Edith, as well as several grandchildren.

Fritz Haas was born in Frankfurt, Germany, on 4 January 1886 and was associated with the Natur-Museum Seckenberg, Frankfurt, Germany, as Assistant Keeper of Invertebrate Zoology and Keeper of Invertebrate Zoology from 1911 until 1936. In 1938 he was appointed Curator of Lower Invertebrates at Field Museum of Natural History, Chicago, a post he held until 1958, when he was appointed Curator Emeritus of Lower Invertebrates. A bio-bibliography of his 385 new taxa and nearly 30 scientific articles was published by Alan Solem (1967, *Fieldiana* : Zoology, **53**, 69–144). Since then, two summary studies on the unionacean clams by Fritz Haas have been published : a species level monograph of the "Superfamily Unionacea" in *Das Tierreich*, **88**, i–x, 1–663, 5 figs. (January 1969), and a generic review of the "Superfamily Unionacea" for the *Treatise on Invertebrate Paleontology* (N), Mollusca 6, **1**, N411–N471, figs. D15–D60 (1969), The manuscript of the latter had been completed in 1950. Several faunistic studies on the non-marine Mollusca of Colombia, in collaboration with Alan Solem, are still in preparation.

While his first love in research was the unionid clams, Haas published extensively on South American Mollusca and material from Spain. His "Bivalvia" report (1929–56) in Bronn's *Klassen und Ordnungen des Tierreichs* remains the standard work in its field.

The above summarises his career and productivity, but says little about the man. A lover of language, a gentle and quiet person, a scholar and a gentleman, he will be deeply missed by many.

Alan Solem

J. Conch. *27:* 183–189 (1970)

RECENT ZONITIDAE IN HUNGARY

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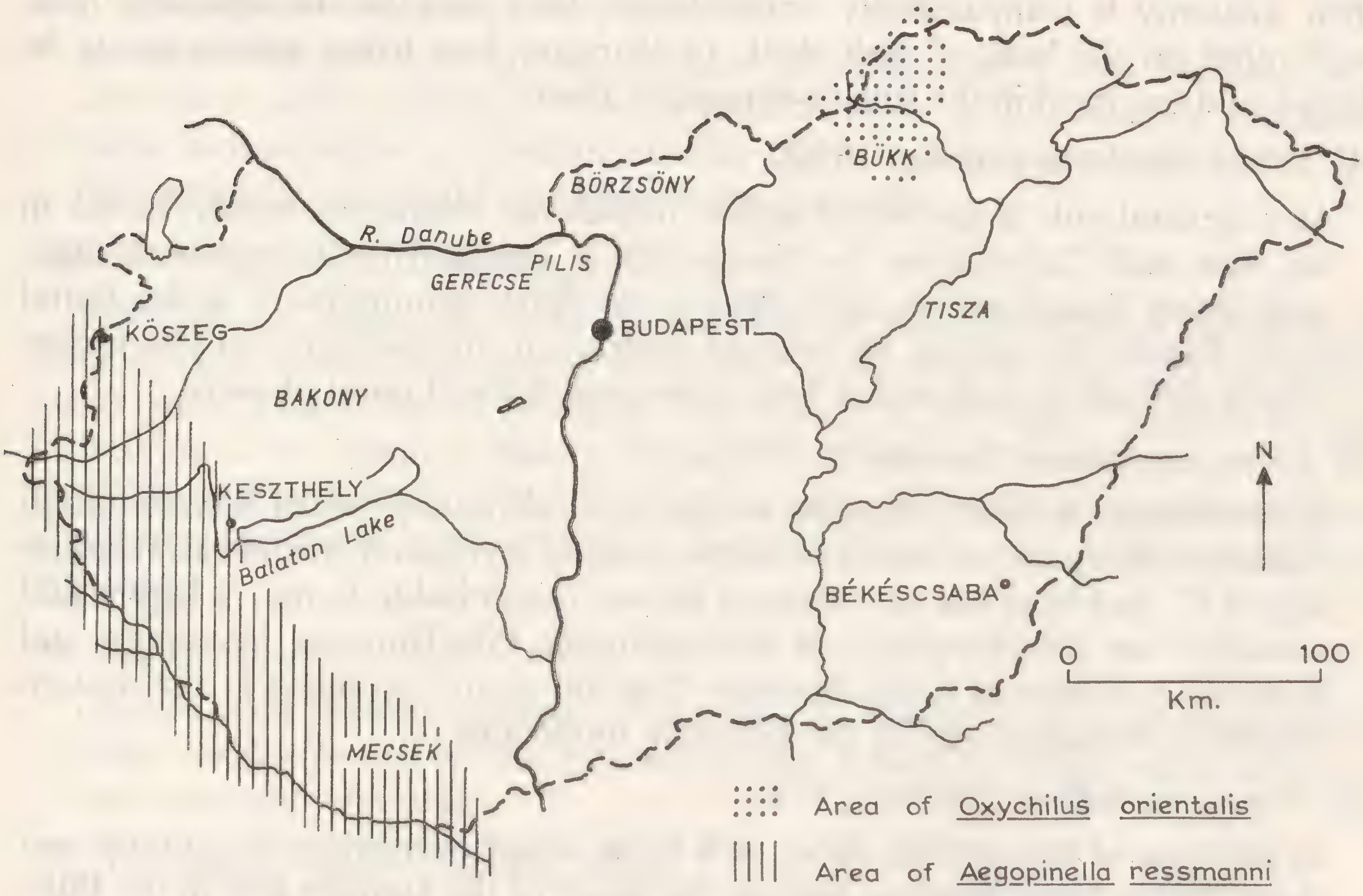
(Read before the Society, 20 May 1967)

The complete revision of Hungarian Mollusca which was started in 1966 has already brought much new information to light. Although we cannot regard this work as nearing completion—many more years' systematic research with the collaboration of all Hungarian malacologists will be required—some preliminary results, which may be regarded as certain on the basis of work done to date, seem worth recording. The revision of the family Zonitidae with several other groups was undertaken by the present author.

Before considering the Zonitidae in detail the zoogeographical position of Hungary in relation to Europe and Asia is outlined in order that the origin of the fauna may be more readily appreciated. From the zoogeographical researches of Soós (1934) we understand the Hungarian fauna to be an integral part of the Carpathian basin fauna with much endemism, strong southern and eastern influences, and a comparatively high percentage of alpine elements. But recent research has shown conclusively that the fauna of the Carpathian basin could



only be regarded as "Hungarian" if the former Hungarian territories of Transylvania, Croatia and the mountain ranges of the Carpathians were included because only these areas had been examined in detail and their special fauna dominated the whole faunal picture. We hardly knew anything of the Hungarian central highlands, the hilly country, and the lowlands. Present day Hungary shows very little zoogeographical connection with the endemism of the Carpathians, and southern elements are only to be found in the southern and south-western regions of the country. The present situation may be summarised as follows.

Zoogeographically, Hungary is directly connected with the Alps and with the ranges of the northern Carpathians. This is evidenced in the molluscan fauna, as 90% of the basic fauna consists of general central European elements, but some southern and eastern species also occur. This view seems to be valid for the family Zonitidae. Some central European species are generally distributed and there are also to be found some southern, almost Mediterranean species.

Among the sub-families of the family Zonitidae there are four in the Hungarian area with nineteen species living now and one known from a stream-deposit only.

I. sub-family: Vitreinae

Genus: *Vitrea* Fitzinger, 1833

Tiny animals, living deeply hidden, but in most cases gregariously, easily recognised by their closely-coiled and nearly colourless, transparent shells. As their anatomy is comparatively undeveloped, they may be distinguished from each other on the basis of their shell. In Hungary four living species are to be found, and one dead in the stream-deposit of Tisza.

(1) *Vitrea diaphana* (Studer, 1820)

As a general rule a species of alpine meridional character, mostly found in the Alps and Carpathians. In Hungary it is common in the northern highland, living abundantly in the valleys of the Bükk mountains. It is also found in the Bakony mountains. Its isolated existence in the southern Mecsek mountains is difficult to understand from a zoogeographical point of view.

(2) *Vitrea subrimata* (Reinhardt, 1871)

Its distribution is nearly the same as that of *V. diaphana*, but of more southern character. Its systematic status is not yet cleared up entirely, neither its relationship to *V. diaphana* nor the status of its two recognizable forms: a bigger and a smaller one. In Hungary it is general in the Pilis-Dunazug mountains and in the hilly country of Com. Somogy. This tiny form is at home at the western frontier of Hungary and in the Börzsöny mountains.

(3) *Vitrea crystallina* (Müller, 1774)

As the data of the revision show, it is to be found everywhere in suitable wet places, but in large numbers only on the banks of the Danube and in the Bükk mountains. It is a species widespread in Europe.

(4) *Vitrea contracta* (Westerlund, 1871)

It is mostly to be found, deeply hidden, in the rocky biotopes of the highlands. The data show a general distribution.

(5) *Vitrea transsylvanica* (Clessin, 1877)

This Transylvanian endemic species has been obtained only from the stream-deposited of the Tisza. Empty shells occur in comparatively large numbers.

II. sub-family: Zonitinae

Genus: *Aegopis* Fitzinger, 1833

(6) *Aegopis verticillus* (Lamarck, 1822)

The genus is represented in Hungary by a single species. It may be gathered in quantity in suitable places in the western and south-western mountains. It likes large stones and rocks.

Genus: *Nesovitrea* Cooke, 1921

The systematic value of the species belonging to this genus has been the subject of much debate in conchological literature. As I have not had any opportunity of working with a quantity of comparative material, I cannot form an opinion of the question. Therefore for the species existing in Hungary I have used the traditional name:

(7) *Nesovitrea hammonis* (Ström, 1765)

Its distribution is little known, because in most cases it was confused with *Zonitoides nitidus* (Müller). It seems to be at home in hilly country and sometimes in mountains too, and in suitable places it is frequent everywhere. We have scarcely any reliable data about the lowlands.

Genus: *Aegopinella* Lindholm, 1927

Although the researches of Riedel and Forcart have established the status of the European species belonging to this genus, the revision of older data has hardly taken place. This is true of Hungary. The matter is not simple. Most of the old collections in the Natural History Museum in Budapest were destroyed by fire in 1956, and since then sufficient spirit material has been collected only from a few scattered areas. On the basis of this material it is only possible to say the following:

(8) *Aegopinella pura* (Alder, 1830)

Identification is easily possible on the basis of the shell. It is common in the Bükk mountains and in the mountains near Keszthely. From other areas we have only scattered data.

(9) *Aegopinella minor* (Stabile, 1864)

Anatomical researches were made only on specimens from the neighbourhood of Keszthely, from the Pilis and Gerecse mountains, as no other material was available. The specimens so far examined belong to this species without exception, although the presence of *Aegopinella nitens* (Michaud) and *A. epipedostoma* (Fagot) also seems possible.

(10) *Aegopinella ressmanni* (Westerlund, 1883)

A characteristic zonitid of south-west Hungary. In the literature this species was sometimes published under name the of *Retinella szépi* Hazay and sometimes under the name of *Retinella hiulca* Albers. It is to be recognized at once by its last whorl being strongly bent downwards and by the finely reticulate shell sculpture. It is very common in Hungary in the south-western corner of the country, roughly within a line drawn from Köszeg to the Mecsek mountains. Ecologically it demands wet wooded ground covered with low vegetation. It lives also in mountains on rocks and under stones.

Genus: *Oxychilus* Fitzinger, 1833

Some forms are hard to evaluate. The genus is found everywhere, and shows great variability.

(11) *Oxychilus glaber* (Rossmaessler, 1835)

The typical form has not yet been found in Hungary, but only one of its eastern variants: *Oxychilus glaber striarius* (West.). It is one of the most common zonitids, and may be collected in great numbers in mountains, on plains, in gardens and cellars.

(12) *Oxychilus inopinatus* (Uličný, 1887)

This species was long placed in the genus *Vitrea*, but recent research has shown that it belong anatomically to the genus *Oxychilus*. In Hungary it is to be found mainly in hilly country, but it avoids high mountains. Until now no living specimens has been found, but the entirely fresh, transparent shells prove the recent existence of the species. We know hardly anything about its way of life.

(13) *Oxychilus depressus* (Sterki, 1880)

Known so far only from the Pilis mountains (three loci) and from the Bükk mountains (one locus). I have found it both on limestone and on andesite. As revision of material proceeds, further finds are to be expected. Neither its systematic standing nor its zoogeographical relations are yet clear.

(14) *Oxychilus hydatinus* (Rossmaessler, 1838)

The existence of this Mediterranean highland species in Hungary was very surprising. At the revision of Gy. Kovács zonitid material I came upon eight specimens, all gathered in the gardens and cemeteries of Békéscsaba, a town in south-eastern Hungary. The accompanying fauna is to be found in molehills: *Cecilioides acicula* (Müller), *Chondrula tridens* (Müller), *Pupilla* *muscorum* (Linné), *Oxychilus inopinatus* (Uličný) and *Aegopinella* sp. The shells are quite fresh, but no living specimen has been found. Continuing local research has shown further rich populations, all of them at Békéscsaba. The specimens agree with Dalmatian specimens, and larger samples from Greece differ only individually. This occurrence is puzzling both ecologically and zoogeographically. Was there perhaps transport with plants, or in flood-deposits of a tributary of the Körös? How could a species which likes only mountains and rocks settle in the middle of the plain? Its nearest habitat is Dalmatia, 500 kilometres away as the crow flies.

(15) *Oxychilus draparnaudi* (Beck, 1837)

It is common over the whole country, and mostly synanthropic. It relation to *Oxychilus cellarius* (Müller) in Hungary is not entirely cleared up. It is probable that all the former *Oxychilus cellarius* data refer to this species.

(16) *Oxychilus orientalis* (Clessin, 1887)

An endemic species of the northern and eastern Carpathians. It is common in the Bükk mountains.

III. sub-family: Daudebardiinae

Three forms have been recorded from Hungary, all regarded as endemic. These are:

(17) *Daudebardia cavicola* Soós, 1927

(18) *Daudebardia rufa pannonica* Soós, 1927

(19) *Daudebardia fallax* Soós, 1955

The problems waiting to be solved are great. First of all the relation of *Daudebardia rufa* and of its supposed Hungarian subspecies *pannonica* is uncertain. Can any difference be proved? Secondly, *Daudebardia fallax* does not differ on the basis of the description of its shell from *Daudebardia brevipes* (Drap.) known from other areas of Europe. Is there really any essential difference in anatomical structure? *Daudebardia cavicola* was described from the Aggtelek stalactite cave in northern Hungary, but since then the possibility of life favourable to the snail has come to an end there and further material cannot be obtained. On the other hand, we have found more and more of such *Daudebardia* shells in different highlands of the country which agree with the *cavicola*-form.

Revision can hardly start, as there is very little spirit material at my disposal. And besides I have not succeeded in getting foreign specimens of the species in question.

IV. sub-family: Gastrodontinae

This sub-family is common in America but has only one genus in Europe: Genus: *Zonitoides* Lehmann, 1862

(20) *Zonitoides nitidus* (Müller, 1774)

This characteristic marsh snail is to be found everywhere in highlands and lowlands, in wet meadows, in the valleys of brooks and on the banks of rivers. It is usually associated with *Trichia hispida* (Linné). The data concerning it, however, demand a careful scrutiny, as it was mistaken for *Nesovitrea hammonis* in many cases.

SUMMARY

In the introduction I have pointed out that the family Zonitidae is on the whole representative of the general zoogeographical situation. In the northern regions of the country, where the mountains touch the northern and north-eastern ranges of the Carpathians, the existence of *Oxychilus orientalis*, a species of typically Carpathian character, is significant. *Vitrea diaphana* too, although spread over a large area of Europe, may be considered a northern, highland species in Hungary. In the south-western corner of the country *Aegopinella ressmanni* gives a south-alpine character to the fauna; and *Vitrea subrimata* (chiefly the smaller form), as well as *Oxychilus depressus*, likewise connect the Hungarian faunal-area to the fauna of the Alps. Southern elements in the family Zonitidae in Hungary are the incomprehensible existence of *Oxychilus hydatinus* and the generally distributed *O inopinatus*.

These data show how strongly the Hungarian molluscan fauna is attached to the basic fauna of Europe. The remaining species also prove the importance of the eastern ranges of the Carpathians, as the elements of the Caucasian fauna which give a very strong colour to the fauna of the Balkans beginning in Roumania and Bulgaria, cannot break through them.

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J. Conch. *27:* 191–195 (1970)

THE IMPORTANCE OF MINERAL PARTICLES IN THE DIET OF *LIMNAEA PEREGER* (MÜLLER)

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(*Read before the Society, 31 January 1970*)

INTRODUCTION

The frequent occurrence of mineral particles in the stomach region of various species of the Lymnaeidae is well known and has been reported by several authors (Owen, 1966). Some disagreement has existed with regard to the degree of importance of such particles in the diet of these snails (Heidermanns, 1924; Boycott, 1936), but the unquestionable need for their presence has been established for *L. stagnalis* by Carriker (1946). Colton (1908) found that with sand present, plant material otherwise untouched by *L. columella* was cut to pieces.

The present study attempts to assess the significance of mineral particles in the diet of *Limnaea pereger* (Müller) by long term and short term feeding experiments on diets with and without sand particles and by examination of faecal pellets and food remains.

METHODS AND RESULTS

The source of laboratory cultures of both snails and food was Willow Lane ditch, Beverley, East Yorkshire (Nat. Grid. Ref. 50/035385), an artificial ditch issuing from Cretaceous chalk underlying Pleistocene boulder clay and by drainage from neighbouring fields harbouring cattle and horses. The ditch bottom is composed largely of silt with occasional sandy patches. In summer there is an abundance of higher plant material consisting chiefly of starwort, (*Callitriche* sp.) and watercress (*Nasturtium officinale* [R.Br.]). The ditch is cleared of much of this material periodically to ensure drainage. Large numbers of *L. pereger* can be seen to browse the bottom mud, the submerged plant material, and the algae which collect in quantity on wood, stones and debris. Occasionally the same species occurs on submerged deposits of treated cellulose, like cardboard boxes and paper.

During the period of study (1967–1970), the alimentary tracts of more than a hundred snails were opened and the contents examined. In all cases, mineral particles occupied the largest volume of the gizzard, crop and pylorus. Inorganic matter also made up the major part of the faecal pellets obtained from most snails collected from various feeding sites in their habitat, and thus it seems likely that this substance comprises the bulk of the material ingested.

For long term experiments, egg masses collected from the habitat were isolated in a glass dish with filtered ditch water, free from mineral particles. Soon after hatching, the young snails were measured using a travelling microscope and then isolated in individual glass dishes containing 50 ml. of filtered ditch water. The dishes were covered and divided into four batches. To each batch was then added one type of food material only. Foods selected for this purpose were those which were available in greatest abundance in the natural habitat: these were fresh dicot. material (leaves of *Callitriche* sp. and *Nasturtium officinale*), filamentous algae (*Cladophora* sp.), non-filamentous algae (chiefly unicellular coccoid forms), and detritus in the form of bark and rotting leaves. The dicot. leaves, filamentous algae and detritus were all thoroughly rinsed and cleaned to remove traces of unicellular algae before being presented to the snails. Acid-washed sand was then added to half of each batch thus prepared. The dishes were inspected at regular intervals and kept replenished with the appropriate foods. Faeces and food remains were examined and the snails were measured at regular intervals and their growth rate and longevity recorded. Two series of experiments were conducted, and in all 59 snails were used. During the course of the experiment the temperature varied from 9°C. to 22°C. Despite all precautions, minute traces of inorganic matter were found in the faeces of a few snails from which it had been excluded in the diet. The results of one of the long term series of experiments are summarised in Figure 1. Each graph represents the growth rate of a pair of snails. Not all the foods offered to the snails were found to be equally acceptable and different cultures of food produced different growth curves. However, it can be seen that in all cases but two the growth rates of the snails with sand present in their dishes are higher than those without sand. In all but one case the snails without sand had died within two months: the snails in the control dishes continued to grow and appeared to be normal in all respects.

A short term experiment, lasting from the time of hatching until six weeks later showed that the mean growth rate for the duration of the experiment was higher by 69% in dishes with sand present in the diet. Only dicot. food was offered during this experiment and twenty-three snails were used.

The faeces produced during the long-term experiments were collected frequently and examined microscopically. Results of these examinations revealed that the material in the pellets from the control dishes was always more thoroughly triturated and generally browner in colour than in that from the experimental dishes without sand. This was particularly noticeable in faeces produced by snails feeding on dicot. material, which was finely shredded in cases where sand had been offered with the food. In the absence of sand the dicot. material occurred in large sheets, appearing to have undergone very little triturition.

Examination of the remains of the food in the control and experimental dishes showed a marked difference. In the batches fed on *Callitriche* sp. the leaves showed obvious signs of wearing, both in dishes with sand and those without. Whereas without sand the leaves had been thinned only in patches, in those

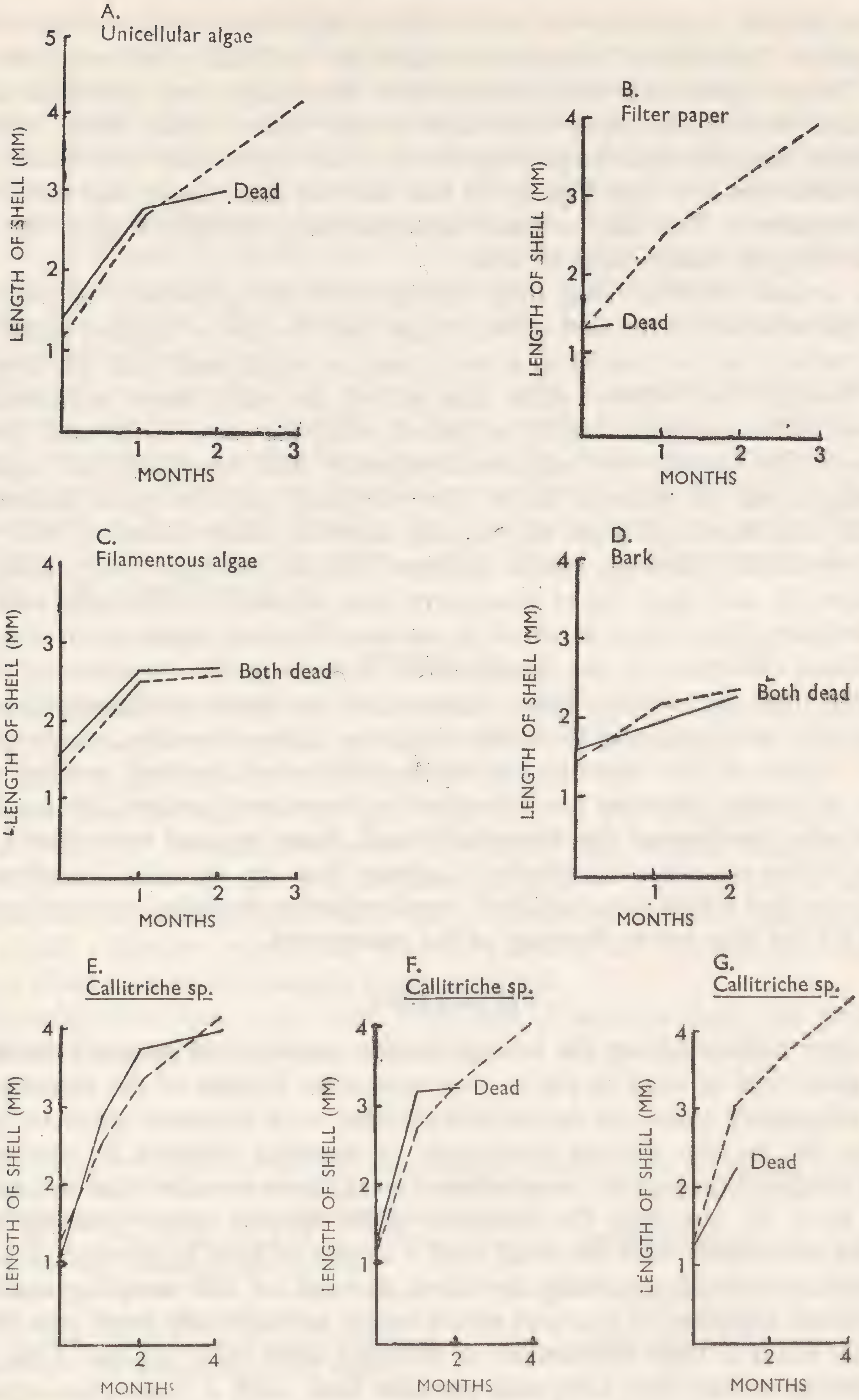

Fig. 1. Results of long-term experiments on *L. pereger* on diets of different foods. Each graph represents a pair of snails. Black line = growth rate of experimental snails:
broken line = growth rate of control snails with sand present.

with sand present, frequently the only evidence of plant material was the stumps of the petiole. More dicot. material was taken by the snails when sand also was offered. In the additional experiments where filter paper was provided as the only source of food, the snails with sand in their dishes could derive sufficient nourishment from the filter paper to grow at a rate comparable with those snails on more orthodox diets (see Fig. 1). In this case the filter paper was worn away almost completely. The snail without sand was dead within 10 days, the filter paper showing no visible signs of wear.

For a second series of long term experiments, the procedure adopted was exactly the same as for the first series, except that the newly hatched snails were allowed to feed for 2–3 weeks in a stock tank in which sand and silt from the habitat covered the bottom. After this period the snails were transferred to individual dishes prepared exactly as before, with the same foods and controls with sand. The faeces were removed frequently and examined for traces of sand using a pair of polaroid filters. The inorganic particles have birefringent properties and stand out from the organic material when viewed in this way. After 9 weeks the following results emerged. Of the 24 snails that started the experiment, 11 had died. Six of these were from dishes in which sand was provided, five were from dishes in which it was not. Of those snails which survived, no significant difference in size distinguished those from the experimental dishes from those from the control. Sand appeared in the faeces of the experimental snails on rare occasions, and then only in traces. Upon dissection, however, the stomach regions of the experimental snails which had survived yielded sand. In 4 out of 6 cases, the sand was abundant in the stomach region. No sand was found in other portions of the alimentary tract. Since no sand was offered with the food of the experimental group, it appears that the quantity found in the stomach was that which the snails had ingestion before isolation, which they had retained for the nine weeks duration of the experiment.

DISCUSSION

L. pereger collected from the natural habitat investigated always have some, often a good deal of sand or silt in their stomachs. Results of the examination of their alimentary tract and faeces indicate that such inorganic particles probably form by far the greatest proportion of material ingested by the snails. Previous studies (Storey, 1969, unpublished work) have revealed that this species of snail feeds by sampling the substrate whilst moving along, making slight pendulum movements with the head until a source of food is detected at which time the amplitude of the swing increases. A result of this sampling could be the accidental ingestion of material which might not normally form part of the diet of the snails if their mechanism of selection were more precise. Thus it is not surprising to find that inorganic particles form such a large proportion of the material ingested when this is the chief component of the substrate: nor is it surprising also that they are the chief constituent of the faecal pellets.

The results of the present study show that the inclusion of mineral particles by *L. pereger* results in more efficient trituration of food materials and influences the rate of growth. In certain circumstances it is possible that the presence of inorganic matter allows this species of snail to utilise materials like paper, which could not otherwise be tackled. For the purpose of the present study, no significance is placed on the different growth rates produced by different foods, as in the case of filamentous algae compared with *Callitriche* sp. or unicellular forms. In such cases the significance lies in the fact that better use was made of the available food in all cases where sand formed part of the diet.

With sand present, dicot. material was taken more readily as food and the quantity ingested was greater.

Additional evidence for the necessity of sand is supplied by the results of experiments showing the capacity of these snails to retain quantities in the stomach region when a replenishing supply is not forthcoming from the habitat.

The long term effect of complete exclusion of sand from the diet of the snails from the time of hatching is that they are unable to derive sufficient nourishment from their food to keep them alive, and a degree of dependence on mineral particles is thus established.

SUMMARY

The importance of mineral particles in the diet of *L. pereger* is investigated by long and short term experiments using cultures of food which would normally be available to the snails in their natural habitat.

The presence of sand in the gut, especially in the stomach region, allows food materials to be triturated more thoroughly than would otherwise be the case. Without sand in the diet, the rate of growth of the snails is adversely affected, but its presence may allow the utilisation of a wider variety of foods than would otherwise be possible. Mineral particles are retained in quantity in the gut when an adequate supply is not provided.

The deleterious, and in the end, fatal lack of sand in their diet from birth establishes the need for its presence in the gut of this species of snail.

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J. Conch 27: 196 (1970)

BOOK REVIEW

Die europaischen Meeresmuscheln (Bivalvia) vom Eismeer bis Kapverden, Mittelmeer und Schwarzes Meer. By Dr. Fritz Nordsieck. Gustav Fischer, Stuttgart, 1969, 256 pp., 7 colour illustrations on 2 plates, 900 pen-and-ink drawings on 26 plates. Price DM 48.

This is a companion volume to Dr. Nordsieck's earlier work *Die europaischen Meeres-Gehauseschnecken (Prosobranchia) vom Eismeer bis Kapverden und Mittelmeer* (1968). The present work deals with the marine bivalves of the area from the White Sea to Cape Verde, as well as with those of the Mediterranean and Black Seas. Dealing with such a large area has inevitably meant much compression in the text, but the shell of each species is described briefly and in addition size, habitat and distribution are given.

The nomenclature is quite alarmingly modern and much "splitting" is evident; *Mytilus edulis* is divided into seven subspecies as well as the nominate race, *M. galloprovincialis* has ten subspecies and a similar expansion occurs with many other species. In fact *Cerastoderma glaucum* boasts of a grand total of twenty-two subspecies (seven of them figured ! One wonders if such fine distinctions are really justified. Although Russell-Hunter has shown that *Hiatella arctica* (L.) and *H. rugosa* (Pennant) cannot be separated Dr. Nordsieck has not only retained them as distinct species but has allocated to the former five subspecies and to the latter four.

Three new subspecies (*Chlamys bruei coeni*; *C. bruei pulchricostata* and *Tetrarca* (misspelled *Tetrara*) *imbricata ibizenca*) are beautifully illustrated in colour. The 900 pen-and-ink illustrations form an important part of the work and a spot check showed them to be satisfactory.

There is a full index and on pages 254–6 a supplement to the first volume (Prosobranchia).

This book is not really suitable for a beginner, but as a checklist of marine bivalves of Europe and of Africa south to Cape Verde it is most useful and fills a gap in current conchological literature. Such a work was much needed and it is to be hoped that Dr. Nordsieck will give us another volume covering the remaining shelled Mollusca of the area.

Nora F. McMillan

J. Conch. *27:* 197–203 (1970)

SOME IRISH NATURALISTS, MOSTLY CONCHOLOGICAL

Nora F. McMillan

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(*Read before the Society, 15 November 1969*)

The first Irish naturalist we know of is the Irish monk Augustin who lived in the seventh century. He tells us something of the Irish fauna of his time but unfortunately he does not mention Mollusca. A thousand years later Dr. Gerard Boate (1604–1649), a Dutchman who was a physician to King Charles I, wrote a *Natural History of Ireland in Three Parts.* He had never been to Ireland, but his book, based on material supplied by others, gives an excellent account of Ireland and ran through several editions.

John Templeton (1766–1825) was, I think, our finest Irish naturalist. He was born in Ulster and lived unadventurously there all his life, his furthest trip apparently being a short visit to Scotland. He published very little but for many years gathered materials for a flora and fauna of Ireland, unfortunately never completed. His Journal and other MSS., some beautifully illustrated, are in the Ulster Museum and well worth seeing. It is curious that no portrait of Templeton is known and the only contemporary account of him is what Andrew Caldwell of Dublin wrote to Sir James Edward Smith on Christmas Day 1798 "Mr. Templeton has been in town [Dublin. NFMcM] for a few days. He is an alert active botanist; knows everything at sight. He picked up a *Chlora perfoliata* : it seemed as much joy as a good prize in the lottery."

Templeton took all botany and zoology for his field; his MS. *Flora Hibernica* includes all the cryptogams, often beautifully illustrated with water-colour sketches. He also left an interesting account of the local Mollusca and this has been published, the non-marine species by A. W. Stelfox and the marine by N. Fisher. After Templeton's death his collection of shells was presented by his family to the Belfast Museum (now incorporated in the Ulster Museum) but the specimens were added to the general collection and are now unidentifiable except for two *Haliotis tuberculata* (certainly not local).

A contemporary of Templeton's was James Dowsett Rose-Cleland (or Clealand) (1767–1852) of Rathgael House, Bangor, Co. Down, who was equally energetic but in a much narrower field. He was an enthusiastic conchologist, pioneered dredging for scientific purposes, and in 1819 added the pretty little tortoiseshell limpet (*Patelloida tessulata*) to the Britannic fauna. He sent specimens to James Sowerby who named them *Patella clealandi* but alas! the name had to yield to the earlier *tessulata* of Müller. Two letters from Rose-Cleland to G. B.

Sowerby I make interesting reading. Rose-Cleland complains that "my Patellas are nearly extirpated" because fashionable visitors paid local children to collect them in large numbers! He also refers to his "new nondescript Trochus" (now *Cantharidus clelandi* Wood) and says how rare it is. Rose-Cleland had a large collection of shells which survived until quite recently but I have failed to ascertain its fate.

Another Ulster naturalist was James Lawson Drummond (1783–1853). He was a medical man, a good all-round naturalist who wrote *Thoughts on the Study of Natural History* and *Letters to a Young Naturalist* and at the time of his death had nearly ready for the press a work on conchology.

Captain Thomas Brown (1785–1862) was born in Perth but while in military service was stationed in Ireland for some years and collected Mollusca assiduously. He published an early list of Irish shells (in the *Trans. Wernerian Society* in 1818), and after his regiment was disbanded he eventually took up scientific work for a living. Finally he became Curator of the Museum of the Manchester Natural History Society and held that post until his death in 1862. His collection of Irish shells went to Lady Jardine of Applegarth (Dumfries) to enrich the museum at Jardine Hall.

Dr. William Turton, although not Irish (he was born in Gloucester in 1762 and died in Bideford in 1835) lived in Dublin for some years and during his sojourn there he produced the first list of Irish shells. It appeared in the *Dublin Examiner* of July 1816 (Capt. Brown's list of Irish shells was read before the Wernerian Society on 16 December 1815, but was not published until 1818 although a pre-print appeared in 1817).

William Andrews (1802–1880). Though born in Chichester, Andrews was (to quote Jeffreys), "an active and indefatigable Irish Naturalist who made many important discoveries in both the flora and fauna of his adopted country". His best find was the Spotted Slug of Kerry (*Geomalacus maculosus*) which he discovered in the autumn of 1842 "on rocks around Lough Carrough [=Caragh NFMcM] to the south of Castlemain Bay, Co. Kerry". He also claimed to have taken *Planorbarius corneus* at "Loch Niscaul" [=Anscaul] on the west side of Caherconree Mountain in 1841—a most unlikely habitat. Stelfox, who made a fruitless search in the lough, has pointed out that the Pyrenean land-snail *Elona quimperiana* Fér. bears a somewhat superficial likeness to *P. corneus* and remarks, "Yet the occurence of *Elona quimperiana*, a land-snail whose continental range is so similar to that of several species of plants and animals which occur in the south-west of Ireland, is not beyond the bounds of possibility." Some of Andrews' plant-records, however, are very doubtful.

In the first few decades of the last century Cork boasted a group of energetic naturalists, among them the conchologist John D. Humphreys (1775–1864). He was a Quaker and was librarian for many years to the Royal Cork Institution. He wrote a good list of Mollusca for the *Contributions towards a Fauna and Flora of the County of Cork*, compiled for the British Association visit to Cork in

1843, and published by the Cuvierian Society of Cork in 1845 (this volume was the forerunner of all the British Association guides and handbooks), corresponded with G. B. Sowerby I and supplied him with Irish shells and minerals. *Buccinum humphreysianum* Bennett was named for Humphreys (its discoverer) in 1824. His shells were purchased from his widow and presented to the Royal Cork Institution. On the demise of the Institution in 1845 the natural history collections were transferred to the new Queen's College and became the nucleus of the natural history museum there.

A little later, and at the other end of Ireland, a group of workers in Ulster took part in the Belfast Dredging Committee's activities in the eighteen-fifties and contributed largely to our knowledge of the marine fauna of the north of Ireland. The conchologists of the group were George Crawford Hyndman (1796–1867) a Belfast auctioneer, and Edward Waller (1803–1873) of Finnoe House, Co. Tipperary. Waller was a barrister who first found *Circulus striatus* (Philippi) at Bundoran, west Donegal, and thereby added one of our rarest molluscs to the Britannic fauna. It is still a great rarity as a British species; a single shell from Portrush, Co. Antrim, and another from Killala Bay, Co. Mayo, being the only localities additional to the original one. Jeffreys also took the species at Bundoran, but I know of no recent finds there. Hugh Allingham the poet lived at nearby Ballyshannon and was interested in the Mollusca (I have some of his conchological books), but he never got a specimen of *Circulus*. Waller also drew attention to the Turbot Bank, a curious submerged bank of dead shells, some of them Arctic species, lying across the entrance to Belfast Lough. This bank has never been investigated properly and a study of its fauna might yield results of importance.

Waller was also responsible for identifying *Limnaea involuta* Harvey as a form of *L. peregra* (Müller) and A. G. More published this after Waller's death. His collection of shells was acquired by the National Museum, Dublin, and incorporated into the general collection.

A contemporary of Waller was William White Walpole of Dublin whose fine collection was advertised for sale in 1867; it was bought by P. B. Mason whose collection later passed to R. Winckworth. Winckworth disposed of the non-marine portion of the Mason shells to A. S. Kennard, and added the marine species to his own collection, much of which is now in Liverpool Museums.

The great William Thompson (1805–1852) was the son of a Belfast linen-merchant and as he was well-to-do and unmarried he was able to devote his life to the study of natural history in general and his *Natural History in Ireland* in particular. The three volumes dealing with birds appeared in 1849–1851, but then, at the early age of 47, Thompson died, leaving his notes on the rest of the Irish fauna in a very incomplete state. After his death these fragments, including the Mollusca, were published as vol. 4 in 1856. Thompson had correspondents throughout Ireland and in the pages of vol. 4 one meets the names of very many early Irish conchologists. Prof. G. J. Allman sent him nudibranchs, Edward Forbes joined him and Robert Ball in a trip to the west of Ireland, and numerous lesser luminaries sent him specimens and records. One would like to know more of some of those who thus helped him. Of Mrs. Clewlow, for instance, whose address is given as Charlemont (? Co. Armagh), and of Mrs. W. J. Hancock who collected largely about Ballysodare and Bundoran, both on the west coast.

Both Hyndman's and Thompson's collections of Mollusca went to the old Belfast Museum with which both workers were so closely connected, and which is now incorporated in the Ulster Museum.

James Bryce, junior (1806–1877) was a mathematics master in the Belfast Academy, a geologist and mineralogist who published in 1831 a catalogue of the school museum entitled *Tables of Simple Minerals, Rocks, and Shells with local catalogues of species.* Together with Hyndman (q.v.) he contributed a good list of shells from the Belfast Waterworks boulder-clay to Portlock's *Geology of Londonderry* (1843).

William Henry Harvey (1811–1866), the great algologist, was born in Limerick of Quaker stock. As a young man he was an enthusiastic conchologist and planned two books, *Testacea Hibernica* and *Bivalvia Hibernica*; in September 1829 he wrote despairingly, "I am busy now in my leisure time drawing plates for the *Testacea Hibernica.* Will it ever be finished?" However, although the plates were prepared the books were never published.

George James Allman (1812–1898). A man of parts! Born in Cork he was a B.A. and M.D. of Dublin who abandoned both medicine and the Bar for natural science, became Professor of Botany in Dublin University, and famous for his work on Polyzoa and Hydroids. He was also interested in the Mollusca, especially in the opisthobranchs and his claim to inclusion here rests upon his discovery of the curious little salt-marsh species *Alderia modesta* (Lovén) at Skibbereen, Co. Cork, and thereby adding it to the Britannic fauna.

Robert Ball (1802–1857) of Dublin was particularly interested in cephalopods; his eldest son Sir Robert Ball became Astronomer Royal.

Other conchologists in Dublin about this time were Miss Mary Ball (a sister of Robert Ball, q.v.), Thomas William Warren (a MS. list of shells with localities compiled by him about 1836 (?) is in the National Museum, Dublin), Dr. Charles Farren and M. J. O'Kelly (to whom Turton often refers).

Robert Patterson, F.R.S. (1802–1872) wrote widely on zoological subjects and published several books much used in their day. His son Sir Robert Lloyd Patterson (1836–1906) specialised in birds and his book *The Birds, Fishes and Cetacea of Belfast Lough* is still of interest. Another descendent (a grandson) was the mighty Robert Lloyd Praeger (1865–1953) who for nearly seventy years devoted himself to the study of the Irish flora. In his early days he also did important work on the fauna of local glacial and postglacial deposits, especially on their Mollusca, and his *Natural History of Ireland a Sketch of its Flora and Fauna* (1950) summarises briefly our knowledge of Irish Mollusca (pp. 225–235). This work, although published by Collins, is not one of the *New Naturalist* series. Indeed, on the whole the *New Naturalist* authors seem hardly to be aware that Ireland's interesting flora and fauna exist.

As editor for very many years of the *Irish Naturalist* Praeger knew almost every Irish naturalist, and in his rather stately autobiography *The Way that I Went* he wrote of many Irish scientific workers he had known.

The Rev. Benjamin James Clarke (who flourished about the middle of the last century) was a good conchologist and particularly interested in slugs. He was far ahead of his time in his treatment of them and one would like to know more of him. His MS. naturalist's diary, kept when he was living at a place called La Bergerie, near Portarlington, Offaly, is in the National Museum, Dublin, and shows him to have been a careful observer and an all-round naturalist.

Henry Chichester Hart (1847–1908) of Co. Donegal, was a man of magnificent physique, a tireless walker and climber, whose main interest was the flora of his native county (*Fl. Donegal*, 1898). He also did some work on the marine Mollusca and his rather rambling "Notes on the marine Mollusca . . . of Donegal and Dublin" appeared in the *Zoologist* of 1892.

James Napier Milne (1841–1918) was a schoolteacher, a good entomologist who also worked on the non-marine Mollusca. He did much good work in the north of Ireland but preferred that others should publish it.

In Samuel Alexander Stewart (1826–1910) we have one of the very few working-men naturalists, comparable with Thomas Edward the cobbler of Banff and Robert Dick the Thurso baker. Stewart was a trunkmaker and a self-taught naturalist who became a fine critical botanist (both flowering plants and mosses) and also did notable work on local Quaternary geology, working out the Mollusca of these deposits. Stewart was always desperately poor and only had Saturday afternoons and Sundays for field-work so to avoid wasting time he sometimes slept out under a sheltering rock. On one occasion an angry ram also desired to shelter under the same rock as Stewart and the latter was fairly driven forth into the night! His death at the age of 84 was due to a street accident.

Miss Amy Warren (about 1840–1932). Amy Warren's full name was Amelia Elizabeth Mary Warren, the younger sister of Robert Warren the ornithologist. For nearly sixty years the family lived near Ballina, Co Sligo, and while there Miss Warren studied the Mollusca and produced a good list of the marine species of Killala Bay, including such rarities as *Circulus striatus*. Her collection, unfortunately in a state of confusion, eventually reached the National Museum, Dublin.

Willim Swanston (1841–1932) who attained the ripe age of almost 92 was a linen-merchant, a student of Oliver Goldsmith and a good geologist. He is remembered for his important work with Lapworth on graptolites, but he also worked on the Mollusca and took part in the Royal Irish Academy's deep-sea expedition in the *Lord Bandon* in 1885. I knew Swanston in his old age and possess a local shell list (MS.) he compiled, embellished with delicate little sketches.

Maude Jane Delap (1866–1953) of Valentia Island, Co. Kerry. Miss Delap's best-known work was on the life-histories of hydroids and medusae under the guidance of E. T. Browne, but her interests embraced almost the entire field of Irish natural history. Her only published note on the Mollusca gave some new localities for *Geomalacus*. Another Delap, the Rev. Alexander Henry, was also interested in the Mollusca and contributed "The Mollusca of Clonmel" to *Sci. Gossip* in 1886.

Nathaniel Colgan (1851–1919) was born in Dublin and lived there all his life. A fine botanist (*Fl. Dublin*, 1904) he later worked hard on the marine Molluscs, especially the opisthobranchs, and his papers on the Dublin marine fauna are full of original observations. During the Clare Island Survey he undertook the marine Mollusca (and Stelfox the land and freshwater species).

Robert Francis Scharff (1858–1934) was of German parentage but for thirty-one years he was Keeper of the Natural History Division of the National Museum, Dublin, and is therefore included here. His zoological interests were wide but he did good work on the non-marine Mollusca, especially slugs, although his main interest lay in the distribution of animals. He was an original member of the Conchological Society.

Robert John Welch (1859–1936) was a superb photographer and one of his favourite tales was how he induced Queen Victoria, when she was visiting a Belfast shipyard, to stand on a box so that she could be seen better and photographed more easily! Welch had an implacable conviction that natural history was *the* interest for everyone and he crusaded vigorously to this end. He was particularly good with youngsters as I remember gratefully, and it was through Welch that forty years ago I met Dr. J. W. Jackson, now (March 1970) senior member of the Conchological Society, who promptly enrolled me as a member. Welch had a wonderful eye for likely country for his favourites, the non-marine Mollusca, and was a tireless collector. His collection is now in the Ulster Museum as well as his priceless collection of photographic negatives.

Robert Albert Phillips (1866–1945) was a representative for the firm of Guy & Co. of Cork and he "travelled" the south of Ireland all his life. He had a fine critical eye, became an excellent botanist and then grew interested in the non-marine Mollusca also. Later, he and Charles Oldham and Stelfox joined forces in what he described as "a beginners' class in Pisidia" and after some years' work order began to emerge out of chaos and the British species are now firmly established. It is hard for us to appreciate the difficulties under which Phillips did his excellent work. He carried his *Pisidium* collection round with him in two suitcases, and during long slow railway journeys he would try to get an empty compartment so as to do a little work on his shells. Then, in a cold and poorly-lit hotel bedroom he would work on doggedly until he was satisfied. In letters to Stelfox over many years (and which I have been privileged to read) he puts forward many interesting theories and remarks rather sadly, "But I never meet anyone to discuss these things with!"

George Philip Farran (1876–1949). Farran, a Dublin man, will be remembered for his important work on zooplankton, especially copepods, but he also wrote, earlier, on Irish opisthrobranchs. This was largely when the marine laboratory at Ballynakill, Co. Galway, was in operation.

Anne Letitia Massey (–1931) held for 25 years a "temporary" post in the Irish Fisheries (Dublin) as conchologist. She produced a series of valuable papers on Irish marine Mollusca, especially of the Irish Atlantic slope, as well as working out the Mollusca of Antarctic and other expeditions. G. P. Farran wrote of her 'she was a careful, critical and accurate worker"—a pleasant epitaph.

Arthur Wilson Stelfox is still happily with us and still deeply interested in Irish natural history. I need not mention his work on Pisidia, Hymenoptera, cave-bones, sedges—in fact, all the groups that lesser mortals quail before!

These brief notes have been gathered from many sources and over many years. I have drawn on Praeger's *Some Irish Naturalists* (1949), the *Centenary Volume of the Belfast Natural History and Philosophical Society* (1924) and to a lesser degree on innumerable other references. Finally, to the reminiscences of my old friend the late Robert Welch, M.Sc., M.R.I.A., and to those of another friend, Mr. A. W. Stelfox, A.L.S., M.R.I.A., I owe a great deal.

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REVIEWS

Das Tierreich, Lieferung 88, *Superfamilia Unionacea* by Fritz Haas. Berlin: Walter de Gruyter & Co., 1969, pp. i–x, 1–663. $10\frac{3}{4}$ ins. by $6\frac{3}{4}$ ins., paperback. Price DM 380.

The study of the larger freshwater mussels constituting the superfamily Unionacea owes much to the efforts of three men, the first, Dr. Isaac Lea (1792–1886) was responsible for the pioneering "A Synopsis of the Family of Naiades" the first edition being published in 1836, subsequent revised editions appearing in 1838, 1852 and 1870.

Lea's works provided a foundation upon which Charles Torrey Simpson based his classic "Synopsis of the Naiades, or Pearly Fresh-water Mussels", published in 1900, this being followed by his "Descriptive Catalogue of the Naiades" published posthumously in 1914.

Dr. Fritz Haas provides the third of these outstanding workers on this attractive and interesting group with the publication of the above work which forms the culmination of a lifelong study, numerous authoritative papers on the group having been produced from his prolific pen from as far back as 1908 to the present day.

The publication of works of this importance and magnitude is unhappily of rare occurrence resulting in a review which may appear excessive in length, my only defence being that even this does not give sufficient justice to a milestone in Naiad taxonomy.

Pages vii–x consist of a systematic outline of the work which departs considerably from that of Parodiz and Bonetto, 1963 (*Malacologia* I, 179–213) in being based primarily upon shell charcteristics.

An introduction to the Superfamily Unionacea, including brief notes on anatomy, shell terminology, previous classifications and shell variation occupies pages 1–9.

On page 5 the typical Unionid glochidium is compared with the recently re-discovered lasidial larval stage of South American Mutelids, both of which are illustrated although lacking a descriptive key to their lettering. Since the illustration utilized for the lasidium is taken from one by Bonetto, 1962, it seems a grave omission that no mention is made of the newly discovered haustorial larva characteristic of African species of *Mutela* which was described by Fryer in 1961 (*Phil. Trans. R. Soc. Ser. B* **244**, 259–298).

Page 9 commences the systematic portion of the work, beginning with the Margaritiferidae and in this connection I should like to correct the authorship of *Margaritana durrovensis*, 1928, the author being R. A. Phillips and not Bloomer as stated, also Bloomer and Phillips both consistently used the genus *Margaritifera* and not *Margaritana* as implied by Haas.

The family Unionidae Fleming, 1828 begins on page 14. Haas quoting the authorship of *Unio* as being Retzius, in a thesis delivered to the University of Lund but it is now generally conceded that Philipsson is the actual author of the Genus *Unio*, as well as of the species *Unio tumidus* and *U. crassus*.

The division of *Unio pictorum* (Linnaeus), pp. 22–29, into twelve subspecies plus the nominate race seems to be excessive bearing in mind that these "subspecies" intergrade, being in all probability nothing more than ecological variants, the same being true for the subspecies placed under *Unio elongatulus* C. Pfeiffer. In this latter grouping it seems a contradiction of the laws of Priority for *Unio mancus* Lamarck, 1819 to be a subspecies of *Unio elongatulus* C. Pfeiffer, 1825.

Mya batavus Maton and Rackett, 1807 is considered to be a subspecies of *Unio crassus* Philipsson but since the species was based upon material from the River Kennet this attribution is impossible since *Unio crassus* is extinct in the British Isles, Maton and Rackett's so-called species being in fact a stunted form of *Unio pictorum* (Linnaeus).

The subgenus *Monodontina* Conrad of Gould's genus *Pseudodon* is described with *Margaritana vondembuschiana* Lea as type species. It tends to be confusing therefore to find that the first species discussed in the subgenus is *Pseudodon* (*Monodontina*) *cambodjensis* (Petit) the type species not being discussed until page 135. An even more glaring case occurs in the genus *Caelatura* Conrad (pages 163–188) with *Caelatura aegyptiaca* (Cailliaud) as type species of *Caelatura* proper this subgenus being preceded by the subgenera *Grandidiera* Bourguignat, *Kalliphenga* Haas, *Kistinaia* Haas, *Mweruella* Haas (considered as a distinct genus by Pain and Woodward, 1968, *Revue Zool. Bot. afr.* 77, 1–2), *Rhytidonaia* Haas, *Laevirostrist* Simpson, *Zairia* Rochebrune and *Zairiella* Haas. It would have been preferable to have described the nominal subgenus and type species first especially as this has been done in the early portion of the work.

The genus *Nyassunio* Haas is dealt with on pages 162–163, but no mention is made of *Nyassunio ecclesi* Woodward, 1964 (*Annls. Mus. r. Afr. cent. Ser. 4to. Zool.* **131**) yet *Indonaia khadakvaslaensis* Ray, 1966 is adequately described. Similarly *Grandidiera bloomeri* Woodward (op. cit.) is omitted from *Grandidiera* Bourguignat, pages 164–165, which Haas considers a subgenus of *Caelatura*. He divides the nominal Tanganikan species into two species *C.* (*G.*) *tanganyicensis* (E. A. Smith, 1880) and *C.* (*G.*) *burtoni* (Woodward, 1859) for reasons best known to himself.

Many students of the North American naiades will note with regret the reduction of *Elliptio* (*Elliptio*) *complanata* (Dillwyn) into the synonymy of *Elliptio* (*Elliptio*) *violaceus* (Spengler).

Anodonta cygnea (Linnaeus) is quite different from *Anodonta anatina* (Linnaeus) (see *J. Conch.* 26, 251) with the result that Haas' list of synonyms quoted for *A. cygnea* on pages 329–350 contains references to both species. The resurrection of *Pseudanodonta* Bourguignat as a genus is a pleasant departure from other recent workers on the Palaearctic representatives of the group since the species concerned show striking differences from *Anodonta* proper in their shell morphology, general anatomy, glochidial stages and ecology.

The attribution of the family Mutelidae to Conrad, 1853 on page 548 is incorrect, the family Mutelidae having been described by Gray in 1847 (*Proc. zool. Soc. Lond.* **15**, 129–219). Also, the systematic treatment of this family appears to be over-simplified, presumably as a result of Haas' oversight of Fryer's paper on Mutelid development, a more acceptable classification being that proposed by Parodiz and Bonetto, 1963 (op. cit.).

His inclusion of *Anodontites trapezialis* (Lamarck) and applied species in the genus *Anodontites* Bruguière would appear to be highly suspect, the type species *Anodontites crispata* Bruguière, differing considerably from other members placed in the genus (see Marshall, 1931, *Proc. U.S. natn. Mus.* **79**, Art. 23, 1–16, pls. 1–2).

The retention of the genus *Leila* Gray is most welcome particularly since my recent studies have yielded considerable anatomical differences between members of this group and species generally placed in *Anodontites* (s.l.).

Having studied the genus *Mutela* Scopoli for the last nine years I fail to agree with Haas since he includes only four species, namely *Mutela* (*Mutela*) *dubia* Gmelin, *Mutela* (*M.*) *nilotica* (Cailliaud), *M.* (*M.*) *alata* (Lea), and *M.* (*M.*) *hargeri* F. A. Smith, in *Mutela* (s.s.) especially since the first two are synonyms. This confusion is increased further by the resurrection of the genus *Iridina* Lamarck with *Iridina exotica* Lamarck as type species this again being synonymous with *Mutela dubia* (Gmelin).

The other subgenera of *Iridina* namely *Cameronia* Bourguignat and *Pleiodon* Conrad are distinct from *Mutela* and are generally considered to be subgenera of the genus *Pleiodon* Conrad (Pain and Woodward, 1964, *Annls. Mus. r. Afr. cent. Ser. 4to. Zool.* **130**).

Similarly I strongly disagree with the placing of *Brazzaea* Bourguignat as a subgenus of *Aspatharia* Bourguignat since it differs anatomically being in fact a Unionid (Pain and Woodward, 1969, op. cit.).

The work ends with an efficient index of nearly 60 pages. In conclusion I should like to stress the necessity for all workers on freshwater mussels to possess a copy of this work regardless of its high cost, since not only does it include species described since Simpson's 1914 *Descriptive Catalogue* but, more important still, gives an insight into Haas' concept of the various species living at the present time.

Fred R. Woodward

Marine Shells of Southern Africa by D. H. Kennelly. Cape Town: Thomas Nelson & Sons, 2nd Edition, 1969, pp. (vi) + 123, 2 double-page colour plates, 46 half-tone plates (263 shells figured from photographs), 15 line-drawings in text, 8vo., n.p.

The issue of a second edition of the popular handbook on the shells of South Africa is welcome evidence of the increasing interest in conchology in those parts, fostered effectively by the local Society. The book has been re-written so extensively as almost to constitute a new work, and has been greatly enlarged in scope. Since the original issue, increased activity in Southern Africa has provided definitive lists of species for various localities, some of them compiled by Kennelly himself, and this has produced the opportunity of describing and figuring all known marine species in the area treated, thus greatly increasing the value of the work. Descriptions, though necessarily brief, have been carefully reviewed and modified where this is thought to increase their usefulness to the amateur: sizes and varieties are detailed, and an indication given whether the species is easily recognisable or likely to be confused with others.

The sixteen additional plates are produced on black in similar manner to those re-used from the first edition, but one or two of them fail to reach the same standard of definition. Apart from these, the photographs are mostly adequate for identification purposes.

Early chapters are designed to help the beginner with problems of finding, cleaning, storing and labelling shells: a subsequent chapter deals with some recent discoveries in South African waters, but although there have been notable finds since 1964, these are not included. There is however, a good description, new to the second edition, of the "Wild Coast", extending from the Great Fish River as far as Natal, and described as the area most likely to yield further important information on the South African fauna.

A glossary of conchological terms is useful to the newcomer, although necessarily rather abbreviated; however, it may be misleading to define "mouth" and "teeth" in terms of a shell rather than of its inhabitant. There is a chapter on "Shells and their Stories" designed no doubt to encourage latent interest, and later in the book another on a similar theme headed "Notes on Shells from here and there", with a mention of various species not found on African shores. This appears irrelevant, especially as the data on *Conus gloriamaris* for instance, is out of date. The two chapters could well be shortened into one, dealing entirely with rare shells from the African continent, since there are certainly enough of them. Surely no book with a title such as this one needs to discuss the diet of North American Indians.

"Common Names" come under review, as usual in popular conchological works, and the beginner is justly cautioned about their use. The point is made that the holidaymaker, in the first stages of enthusiasm, loves the aptness of the common names, and cannot be bothered with what he terms jawbreaking latin terminology. This is undoubtedly a frequently met attitude to systematics, but it can hardly be represented as logical when many of those same tourists no doubt go home to argue with their neighbours about their Rhododendrons or Antirrhinums quite without sense of strain.

Pains have been taken to bring nomenclature up to date, and the taxonomy has been carefully reviewed. The synonym *Glyphis* for instance, has been eliminated, and the genus *Thais* is now classified under the Muricidae instead of the curious Thaididae as previously. With a couple of exceptions due to non-availability, all species are illustrated. *Pleurotomaria africana* must have given trouble here, since it is marked "not illustrated", but the book does itself an injustice, since a good line drawing of it is shown on page 42. It is a distinct disadvantage that there is no key to the 46 plates, so that back-reference from them to the descriptions is difficult and lengthy. To the novice, who must first look at pictures, the book may appear confusing until he passes the first stage; however, enthusiasm brings rapid strides in knowledge, and the expert conchologist will find himself still obtaining a great deal of help from the book. From its previous usefulness, the new edition has made it an essential in studying the shells of the area and it is to be hoped that the author will now consider writing a companion volume on the non-marine shells of the same part of the world.

T. E. Crowley

Natural History of the Lake District. Edited by Canon G. A. K. Hervey and J. A. G. Barnes. Frederick Warne & Co., London, 1970. Price £3. Pp.1–230, 8 colour plates, 24 black-and-white plates, text-figs.

This attractive book immediately invites comparison with such "New Naturalist" volumes as those on Snowdonia and Dartmoor, but the dust-jacket of the present work is much more pleasing, and the contents rather more varied. The present volume includes contributions from a team of nine specialists as well as excellent accounts of the flowering plants (also ferns and mosses) and the birds by the two editors respectively. Students of the Mollusca will be pleased to see their favourites dealt with by T. T. Macan (pp. 86–7) though necessarily briefly. Dr. Macan finds room, however, for an interesting history of the enigmatic *Potamopyrgus jenkinsi* in Windermere. There is a further short note on Mollusca, mainly the terrestrial species, on pages 115–116.

It is pleasant to note that invertebrates are generously dealt with in this volume, and a good balance held between the more fashionable groups (e.g. birds and flowering plants) and those less photogenic.

The colour plates are good on the whole, though in one or two (e.g. p. 9, lower) the greens are unsatisfactory. Those in black-and-white are both good and relevant.

An admirable feature is the maps; a good "general" one (scale of $\frac{1}{4}$ in. to a mile) inside both front and back covers, a geological one, and one showing the various features and localities mentioned in the text. Another excellent feature is a chapter giving details of the various organisations in the Lake District with natural history interests as well as particulars of available nature trails, Nature Reserves, field study facilities, etc., etc. A selected bibliography occupies pages 207–210.

The only adverse criticism the reviewer has to make is to enquire plaintively why the obnoxious practice of numbering the pages on the *inner* margins has been followed? This makes page-finding unnecessarily awkward.

No naturalist, whatever his or her interests, who is resident in, or interested in, or contemplating a visit to, the Lake District, should be without this book.

Nora F. McMillan

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MOLLUSCA OF THE IRANIAN PLATEAU-III

H. E. J. Biggs
48 Park Road, Bromley, Kent

(*Read before the Society, 16 May 1970*)

Nine years have passed since my second contribution to our knowledge of the Mollusca of Persia (Biggs 1962). During this period a further attempt has been made to determine the species which remained undetermined after the publication of that paper and some since the publication of my first paper (Biggs 1937). Progress on this work is now reported.

In 1964 Dr. C. B. M. McBurney of Cambridge excavated an Epi-Palaeolithic cave in Masanderan Province on the Caspian Sea coast of North East Persia at Ali Tappeh near Behshar (formerly Ashraf). The mollusca found there have been sent to me for determination. The result of this work, so far as the non-marine mollusca are concerned, was incorporated in a report on the excavation (McBurney 1968). These specimens are now in my collection and as they are of interest to malacologists notes are included in this paper. Where the number of examples of any species are recorded I have only counted those of which there was more than one half of the example.

In the third place Dr. Reinhold Huckriede, of Hanover, working as a geologist studied early quaternary deposits in the Province of Kerman and there found mollusca not previously recorded for the district; the results of his work were published (Huckriede 1961) in a geological journal. As such a paper might be overlooked by malacologists working in the future on Persian mollusca I felt that it would be as well to mention some of them here. Dr. Huckriede has favoured me with a few examples of some of the more important additions to the fauna and these are now in my collection.

Reference is also made here, with permission, to some of the non-marine mollusca collected by W. K. Loftus and presented to the British Museum (Natural History) in 1853. These were probably collected by him whilst a member of the Turco-Persian Frontier Commission in 1842-52, and are almost certainly some of the first mollusca collected for scientific puposes on Persian soil. Loftus was a geologist and archaeologist, he visited Susa (Shushtar) in 1850.

In view of all this I feel the time is now ripe for a third paper on Persian non-marine mollusca.

GASTROPODA

Theodoxus pallasi Lindholm 1924.

The following examples were from the Ali Tappeh cave :—

10,000 B.P.	1 ex.	10,500 B.P.	2 exx.	10,700 B.P.	6 exx.
12,000 B.P.	46 exx.	12,350 B.P.	30 exx.	Total	85 exx.

This species has, for many years, been known as *Neritina liturata* Eichwald but Lindholm has shown that Eichwald's name was preoccupied and renamed it *pallasi*. The measurement of a selected number of shells from the above samples are very much as those given by Lindholm; the zigzag markings, usually a character of the species, are missing from most of the Ali Tappeh specimens which are buff-coloured although a few do show the markings quite distinctly. This presence or absence of markings is exhibited in examples from the same layer and nothing can, at present, be learned from this fact.

There is a paucity of examples from layers of more recent dates and an abundance in the two oldest layers, no suggestion can at present be made to account for this except that possibly the Caspian Sea was nearer the mouth of the cave at that time. That is, perhaps, a point for the archaeologists working in the area in the future.

Caspicyclotus sieversi (L. Pfeiffer 1871)

From Ali Tappeh Cave, 11,000 B.P. 2 exx, 11,700 B.P. 1 ex., 12,350 B.P. 1 ex.; they are all in a good state of preservation. Several species of *Cyclotus* have been described from the Hyrcanian Sub-region of the Palaearctic and Forcart (1935 : 413) has erected the genus *Caspicyclotus* on anatomical grounds for these shells. Schlesch (1934) figures this species and also C. *herzi* O. Boettger.

Valvata cf. piscinalis (Müller 1774)

Huckriede (1961 : 32 & 33) refers to a small form of *Valvata piscinalis* (Müller) from Holocene deposits in the district north of Kerman and then adds that his examples are related to *Valvata piscinalis pulchella* Stüder.* He has kindly sent me 5 examples from marly peat of the pluvial period found at a depth of between 9·8 m. and 10·4 m. in a well in the centre of Kerman town. These appear to be very much smaller than normal British forms and to lack the distinct sculpturing; that latter character may be due to the fact that being fossil samples they are somewhat worn.

No species of *Valvata* is recorded from the Iranian Plateau or from the Caspian coast either by Forcart (1935), Starmühlner & Edlauer (1957), or by Haas (1952), neither did I find any in or near Kerman whilst living there between the years 1923-25 and 1931-35. It seems probable that the species is now extinct at least in the province of Kerman and possibly also on the plateau generally.

Pomatias elegans ssp. *hyrcanum* (von Martens 1874)

This form has been reported (as a species) by many writers on the Caspian coast mollusca. It occurred infrequently but regularly in all layers at Ali Tappeh cave from 10,000 B.P. to 12,000 B.P.

---

* = *macrostoma* Steenbuch; *pulchella* Studer is nomen nudum.

Hydrobia (Hydrobia) acuta (Draparnaud 1805)

In my first paper (Biggs 1937 : 934) I recorded one example of a species of *Hydrobia* from Nain, east of Isfahan. Working through a very long series of duplicate *Melanopsis doriae* Issel from the same locality, which had been left in a box undisturbed since collection, I have now found five more adults and three juveniles of this species. Of the six adults now available the largest is 5·3 mm. in height by 2·3 mm. in breadth and the smallest 5·0 mm. in height by 2·1 mm. in breadth, average for the six examples H. 5·17 mm. by B. 2·33 mm. The three juveniles have not been measured but have 5, 5 and 5½ whorls. These shells I now consider to be *Hydrobia (Hydrobia) acuta* Drap.

Starmühlner & Edlauer (1957 : 445) and Starmühlner (1965 : 180 & 181) record this species from Lake Neiris near Shiraz, Lake Famur near the Dukhtar Pass on the road between Shiraz and Bushire, and also Lake Urumieh (now Lake Reziyeh). The example figured on the left of the two shown on plate 1 fig. f. in the former work referred to above, agrees with my Nain examples. They state that the measurements of the conical (kegelförmigen) examples they obtained are 1·3 mm.–2·3 mm. in width by 3·8 mm.–4·8 mm. in height which measurements approach very closely those of my examples.

Huckriede (1961 : 30) records *Hydrobia (Hydrobia) cf. acuta* (Drap.) as a quaternary fossil from a deposit in the Zerend District north of Kerman and suggests that there was a brackish lake in that area at one time.

Whenever a species which is widely distributed in the Palaearctic Region is found in South Persia nearing the north west limit of the Oriental Region, comparison with series from western Europe is essential. In the British Museum (Natural History) there is a long series of *Hydrobia acuta* Drap. collected by Caziot at Nice and passed to Tomlin who passed them on to the museum (Reg. No. 1938.4.6 46–65). The label on the bottom of the box is in Peile's hand and has has written after the name "+ ?" which seems to mean that he considered some of them not *acuta* Drap. but he does not indicate which ones. The three largest of this series measure height 5·1 mm. × breath 2·3 mm.; height 3·8 mm. × breadth 1·8 mm.; height 4·0 mm. × breadth 1·9 mm. The rest of the series are very much smaller and it may well be that it was the larger ones Peile was querying.

The general shape and proportions of these largest examples are the same as my adults from Nain. It appears that some of the southern European *acuta* can be as large as the normal Persian forms and that normally the small forms are characteristic of southern Europe and the larger of Persia.

However there are also 4 examples in the B.M. (N.H.) collected by Mr. P. J. K. Burton in 1963 at Bundar Gaz in east Masanderan two of which are nearer the size of the smaller examples from Nice. This might be interpreted as suggesting that the form on the Caspian coast approximates generally to the south European form as the general ecological conditions on that coast are nearer those of south Europe than those on the Persian plateau.

Planorbis planorbis (Linné 1758)

Two dead shells were found in the bed of a stream in the fields south of Resht (Gilan Province) on the 12th Sept. 1927, also several in a pond 2 miles west of the Manun Bridge at Isfahan. The Resht examples were determined for me by Dr. Forcart who has recorded the species for the Masanderan Province (Forcart 1935 : 419). Starmühlner & Edlauer (1957 : 462) have also recorded the species for several localities on the Iranian Plateau.

Planorbis spp.

Undetermined examples of *Planorbis* occur in all layers in the Ali Tappeh cave between the dates 11,000 B.P. and 11,700 B.P.

Pyramidula rupestris (Draparnaud 1801)

On 4th July 1932 I took about 20 examples of a species of shell in debris under a tree at about 8,000 ft. in the valley above Seguch south east of Kerman. Owing to their superficial resemblance to juveniles of *Patula biggsi* (Schlesch) these were set aside as duplicates. Recent re-examination has convinced me that they are *Pyramidula rupestris* or some very close relative. In the mountains a few miles east of Kerman I took single examples on two separate occasions in 1933 and 1934. Dr. Kerney agrees that these shells are very close to *rupestris*, if not identical

Hutton and Benson (1838 p. 217) described a species, *Pyramidula humilis* (under the genus *Helix*), and I have compared my Persian specimens with some of this species from Simla now in the British Museum (Natural History) and they appear to me to be very much the same. Taylor (1909; 179) records *Pyramidula rupestris* from the province of Khorassan, North Persia, on the authority of Baron Rosen and the distribution map he (Taylor) gives on page 174 shows the whole of Persia shaded to indicate "probable distribution". The present record confirms that the species lives on the plateau and a very long way south of the Khorassan locality.

Huckreide (1961 : 33) records a *Pyramidula* sp. as a Holocene fossil from a deposit near Kerman and I now suggest that this species could well be either *rupestris* ss. or its far eastern form, *humilis* Hutton and Benson. It is only to be expected that a species distributed in mountainous habitats from the north of Scotland to the Himalaya Mountains should vary to such an extent that some authorities would consider these forms distinct species at the extreme limits of their distribution. Perhaps we should say that the south Persian examples belong to the *rupestris/humilis* complex.

Vertigo antivertigo (Draparnaud 1801)

Huckreide (1961 : 32) has recorded this species from marly peat of the Pluvial Period at a depth of 9·8–10·4 metres in a well in the centre of Kerman and has favoured me with three examples from this locality. Dr. Kerney kindly informed me (v.v.) that had he received them from a British locality he would certainly have given them the above name; it is good to have the determination confirmed. Forcart (1935: 420) records this species from Masanderan. I took no species of *Vertigo* on the plateau; it may well be that the species is extinct on the plateau but survives in the Caspian Sea provinces where the climate is more favourable and nearer the optimum required for survival.

Lauria cylindracea (da Costa 1778) var *caspica* Pfeiffer

I collected six examples of this mollusc in woods behind Pir-i-Bazar, north of Resht on 19th Sept. 1927. Starmühlner & Edlauer (1957: 466) record the species from Masanderan but not the variety. My examples were determined by Tomlin who comments "Westerlund places v. *caspica* as a var of *sempronii* Ch. but the latter is generally considered as a slight variation of *cylindracea*."

Granopupa (Granopupa) granum (Draparnaud 1801)

This species was recorded by me (Biggs 1937: 346) live from the Kerman district; Huckreide (1961: 33) has recorded it also from N.W. of Kerman but as a quaternary fossil. It was also collected by Loftus before 1853 but not recorded in literature. There are ten examples in B.M. (N.H.) Reg. No. 53.10.7 11–20, taken by him at Bamu near Zorab. This appears to be the village on the Iraq/Iran border E.N.E. of Qasr-i-Shirin, 45° 52″ E. × 34° 35″ N. This should be one of the earliest series of specimens collected on Persian soil.

Jaminia (Multidentula) ghilanensis (Issel 1866)

Most writers on the mollusca of the Caspian Sea provinces record this species, the only reason for further notes on the examples from the Ali Tappeh Cave in Masanderan is the fact of their numbers. Including recognisable fragments 278 examples were collected (124 in my collection) from the following layers:—

11,000 B.P. 49 exx.
11,100 B.P. 5 exx.
11,300 B.P. 3 exx.
11,500 B.P. 37 exx.
11,700 B.P. 112 exx.
12,000 B.P. 34 exx.
12,350 B.P. 38 exx.

This species was the most common of all in the Ali Tappeh Cave material, the series shows that in each age represented there was the same wide variety in form, namely variation in height and width but the dentition was consistent throughout judging from examples assumed to be adult by the thickness and amount of reflection of the mouth. Also there was little if any difference between these examples and those collected today. This could be used as pointing to the suggestion that there has been little, if any, change in climatic conditions in the last 12,000 years.

I have used the name *ghilanensis* (Issel 1866) for this species because in Issel's work this name has page priority over *Jaminia isselianus* [Bourguignat MS. (Issel)]; this does not imply judgment as to whether or not the two species are really separable.

Zebrina (Zebrina) eremita (Reeve 1849 ex. Benson MS.)

I have in my collection an example of this species given to me by Tomlin who told me it came from the Caziot Collection. It has a green label and apart from the species name and the locality—"Persia"—no other data. Mr. S. P. Dance informs me that in the Tomlin collection in The National Museum of Wales, Cardiff, there are the following examples from Persia, (a) one example labelled "*Bulimus eremita* Hutt. Persia" (b) six examples labelled "*Bul. (Mastus) eremita* var. *minor*. Ashabad" This latter locality is probably 'Eshqabad which is today just over the frontier and in Turkmenistan.

Boettger (1881) records "*Bulimus* (*Petraeus*) *eremita* (Reeve)" and describes a variety "*germabensis*" from Germab in the Kopet Dagh Mts., presumably on the Persian side of the range as this name means "warm water" in Persian. As this species is not reported from the provinces of Persia at the south of the Caspian Sea but is known to inhabit Afghanistan and Baluchistan it would appear to be an indigenous mountain form and quite likely to be an eastern form of *Zebrina detrita* (Müller) of which it is a rather large and somewhat elongated example.

Zebrina (Zebrina) walteri (Boettger 1889)

One example of this species found in a layer at Ali Tappeh Cave dated 10,100 B.P.: it is in very good condition. This species has not previously been recorded from Persia and may be living in the foothills of the Elburz Mts. Boettger's original locality was Aga Dagh Mts. which are a part of the Kopet Dagh but in Turkmenistan, U.S.S.R.

Subzebrinus (Subzebrinus) purus (Westerlund 1890)

There are two examples of this species in B.M. (N.H.) Reg. No. 1900 11.8.82–83. These were purchased from Naegele who collected them at "Salmas". This is probably the modern Kuneh Shah-i-Salmas west of Dilman near Urumiah. As Westerlund set up this species on material from the same collector and from the same locality these specimens may well be topotypes, if not paratypes.

Subzebrinus asterabadensis (Kobelt 1880)

Six recent examples were included in the material from Ali Tappeh, three were found in a layer dated at 10,700 B.P. and are similar to recent examples. There are also two complete shells and two decollated ones of uncertain date. These last are of the form in which the body whorl is as broad as the penultimate; the others have, mostly, the body whorl narrower than the penultimate. This seems to be the only variation in shell form in all the examples I have examined. This species is at present only known from the south eastern shores of the Caspian Sea.

Succinea (Succinea) pfeifferi Rossmässler 1835

This species is well known from Persia, so no comment is necessary except to state that there were examples, 10 in all, in the Ali Tappeh material dating from 11,300 B.P. to 12,400 B.P.

Parmacella olivieri Cuvier 1804

Again a well known species from Persia, there were no less than 33 examples in the Ali Tappeh material from all the layers of the excavations and evenly distributed.

Opeas gracile (Hutton 1834)

There is one dead shell in the B.M. (N.H.) originally in the Godwin-Austen collection from "Talk". If my deduction is correct this locality is Talkh-ab (Persian "bitter water") between Birjand and Tabas, which extends the present known distribution of the species northwards.

Oxychilus patulaeformis (Boettger 1889)

Tomlin gave this name to one example I collected in the dry bed of a stream near Resht (Gilan Province) 12th Sept. 1927. The species was described by Boettger from examples from Shahrud in Mazanderan Province. It appears to be rare; it is not recorded either by Forcart or by Starmühlner & Edlauer.

Helicella (Helicopsis) crenimago (L. Pfeiffer 1848)

This is a common species in the Ali Tappeh Cave in a juvenile form, there being 126 examples as follows:—

11,000 B.P. 35 exx. 11,100 B.P. — exx. 11,300 B.P. 2 exx.
11,500 B.P. 19 exx. 11,700 B.P. 24 exx. 12,000 B.P. – exx.
12,350 B.P. 28 exx.

These figures show the very uneven distribution of the species in time. Most of them were about two-thirds grown, the largest being about 6·8 mm. in breadth as compared with the 9·5 mm. given by Likharev & Rammel’meier (1952: 425) for the size of the adult. The incidence of this species in the cave is interesting as it is not, to the best of my knowledge, recorded for Persia the other two records being in Transcaucasica although it is true that one of them is in the Aras R. valley but just on the Russian side. The question is, does the species still live in Masanderan or is it extinct?

Here we have a large number of shells whose distribution in time is irregular and we must leave this to the archaeologists to suggest a reason. Was there a change of climate or was the cave not occupied during the periods when no *crenimago* were found in the excavations? Unfortunately I did not find this species in the Gilan Province and can make no suggestion as to its habits.

Xerocrassa seetzeni ([Koch] L. Pfeiffer 1847)

This species was collected by Dr. C. Reed at Naft-i-Shah, 6 kms. south of Khanequin on the Iraq/Iran border in the autumn of 1959. I received 70 examples many of which were alive; his note with the shells is "around low scrub bushes on rocky sandy flats" at an elevation of 1,000 ft. The species is well known from many localities in Iraq, Syria, Israel etc., but this is the first record for Persia. It is only just over the border and probably does not extend very far inland as it is normally an inhabitant of the plains and the piedmont zone. The shells are all white, no examples of the maculated or banded forms, and generally speaking slightly smaller than those in neighbouring countries.

Monacha cartusiana (Müller 1774)

One example collected by Dr. McBurney near Ali Tappeh cave was slightly damaged when received but I feel it must be referred to this species. It has not has been reported as yet from north Persia and the map given by Taylor (1917: 109) shows its known distribution to be to the border of Asia Minor up to the north west corner of Persia but the shading which represents "probable distribution" extends just over the border. The problem remains, why has it not been found by previous very competent investigators into the molluscan fauna of this area. As the species is extremely rare on the north western edge of its distribution i.e. in Suffolk (Biggs 1969: 185) where it may be on the verge of extinction, so also here on the extreme eastern limit it may well be in the same condition.

Euomphalia (Stenomphalia) selecta (Klika 1893) = *globula* Krinicki

Seven live examples were collected in the rice fields south of Resht (Gilan Province) 13th Sept. 1927 from the heads of rice plants (Biggs Coll. Reg. No. 35). This species is recorded by Starmühlner & Edlauer (1957: 473) for many localities in Masanderan Province but it is not recorded by Schileyko (1968) for Talysh just over the border in U.S.S.R. where one would expect to find it as the original locality was the Caucasus. In any case this record fills a gap in the known range of the species.

Euomphalia (Euomphalia) transcaucasica (Mousson 1863)

The material from Ali Tappeh Cave is as follows:—

11,000 B.P.	1 adult, 9 juveniles.	11,000 B.P.	none.
11,300 B.P.	2 juveniles.	11,500 B.P.	3 adults.
11,700 B.P.	1 adult, 36 juveniles.	12,000 B.P.	3 juveniles.
12,350 B.P.	1 adult, 6 juveniles.		

Including identifiable fragments of adults there were 11 in all, but the juveniles total 56 with a strong concentration at 11,700 B.P. Dr. Altena (1962: 97) reporting on mollusca from a Palaeolithic rock shelter in the Lebanon states "Part of the land snails probably were not brought to the locality by man, but lived there or went there for aestivation. The latter supposition seems most probable for the specimens of *Pomatias olivieri* found with the operculum." This explanation I feel adequate for the adults. There were also opercula of *Pomatias elegans* in the strata at Ali Tappeh. However I feel it would not cover the juveniles of *transcaucasica* both in view of the numbers and also that they were found well inside the cave, and also as it faced North-west and they would not need to go so far inside to get shelter from the sun.

At the present moment I am inclined to suggest that they were brought into the cave by late Palaeolithic man with the wild grain he gathered or in the incipient stages of agriculture. Dr. McBurney informs me (*in litt.*) as to the age of the shells "They are all of Palaeolithic or Mesolithic age, that is to say the final hunting epoch immediately preceeding the introduction of the first agriculture and animal husbandry in this area. The estimated age . . . is in the order of 10,000 B.C."

The southern coast of the Caspian Sea was in the zone of distribution of wild two-row barley (*Hordeum spontaneum* Koch 1848) and the occupants of the cave could well have brought these young snails into the cave as they were aestivating on the heads of the barley in the collecting stages of their economy. I collected *Euomphalia pisiformis* (Pfeiffer 1863) from the stalks of rice in the fields near Resht in Sept. 1927 and this locality is further along the coast to the east from Ali Tappeh. Unfortunately I did not look for juveniles of this genus so it is not possible to say in what month of the year juveniles of this genus are of the size of these juveniles of *transcaucasica* in Ali Tappeh Cave otherwise one might have hazarded a guess as to the time of year man harvested his wild grain in that locality and in that stage of his cultural development.

The preponderance of juvenile *Helicella crenimago* in the cave over adults seems to suggest a similar cause but as I did not collect that species in that area one hesitates to couple this species with *transcaucasia.*

BIVALVIA

Unio tigridis Bourguignat 1852.

For the Iranian Plateau this species was recorded by Starmühlner & Edlauer (1957: 48) from the Sivend R. near Persepolis and from Dudeh, east of Shiraz. Reed (1962: 10) collected the species from the river bank, Kara Su R., near Kermanshah and says that he considered this species to have been "the major molluscan protein source . . ." for the population of the prehistoric sites which were being excavated by him and his team near the river. This locality is an extension to the north west of Stamühlner and Edlauer's localities for this distribution of this species in Persia.

Unio (Limnium) hueti Bourguignat 1855.

One very good example collected by Dr. Reed in the Kermanshah area probably east of the town. Length 50·3 mm., height 29·0 mm., thickness 17.5 mm. There is an example of a species of *Unio* in B.M. (N.H.) which appears to be this species with the label "Persia. W. K. Loftus Esq." and on the tablet "mingrelicus" in Tomlin's handwriting. Germain (1936: 396) attributes this species to Drouët 1881. These two species appear to be closely allied if not identical so temporarily I suggest the older name be used. This species has not previously been recorded for the Iranian plateau: the Loftus specimen must have come from the Iraq/Iran border, but may have come from the river near

Susa (Shushtar) as Loftus visited the town in 1850. Reed's example is from the piedmont of Persia.

Dreissena polymorpha (Pallas 1771)

Six valves each in different layers the earliest being 12,350 B.P.

ACKNOWLEDGMENTS

My thanks are due to all who have helped to make it possible to build up this paper. Also to Dr. C. B. M. McBurney for the useful material from Ali Tappeh Cave, and to Mr. J. F. Peake for permission to refer to the unrecorded material under his care in the British Museum (Natural History).

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J. Conch. *27*; 221–223 (1971)

ON A PROPOSED NEW GENUS OF CERITHID MOLLUSCA FROM THE DAHLAK ISLANDS, RED SEA

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(*Read before the Society, 21 March 1970*)

In order to avoid delay in publishing a report (Biggs 1965) on the Mollusca collected by the Polish Expedition to the Red Sea, "Dar Opola", which visited the Dahlak Islands in 1960, a number of small and very small species were left undetermined. Amongst these was a closely allied group, probably consisting of several species and represented by a very considerable number of examples. After careful study it has been found that they cannot be placed in any known genus consequently a new generic name is now proposed to accommodate them.

These specimens were sifted from shell sand collected on Entedebir Island gathered from amongst sand and gravel on the shore. They are mostly worn and all are dead but sufficient very good examples have been separated out and on these it is possible to base the present paper. The correct taxonomic position of the proposed new genus cannot be fixed without fresh material in which the apex is not worn or damaged so that its characters can be studied and a more exact measurement of the height of the shell be made to get an exact average.

Tentatively I suggest the genus be placed somewhere near *Pirenella* and *Cerithidea.*

Dahlakia gen. nov.

Cerithid mollusca, small or very small, 5 mm. in height or less. Nepionic whorls usually worn or absent: whorls averaging 8 (nepionic whorls estimated), well rounded increasing regularly and fairly rapidly in width, ornamented with many close and fine striations, callosities (when present) rather unevenly distributed, nodules (when present) regular: suture deep: mouth pyriform or semilunar and the longitudinal axis at an angle of about 40° to the columella: siphonal canal wide and shallow sloping towards the axis of the columella: lip sharp: shell imperforate.
Type species *Dahlakia leilae* sp. nov.
Type locality, Entedebir I., Dahlak Archipelago, Red Sea.

Dahlakia leilae sp. nov.

Characters generally as for the genus, whorls 9 when fully grown, chocolate coloured and gradually increasing except for the body whorl which broadens quickly in relation to the penultimate whorl, ornamented with cream coloured callosities larger and irregularly placed on the body whorl, smaller and more regularly placed on the spire, all whorls evenly rounded and the suture quite deep; mouth wide, broader than in the following species in proportion to the width of the body whorl, the apical/basal axis of the mouth at about 45° to the columella, lip sharp, siphonal canal broad, distinct and somewhat truncated.

Holotype. Height 5·2 mm. Breadth 2·5 mm. Mouth, height 1·7 mm. Breadth 1·0 mm.

Dahlakia striata sp. nov.

Characters generally as for genus, whorls 7 to 8 uniform light brown in colour and ornamented with fine close and distinct ridges with no callosities or maculations: latitudinal ridges obsolescent at the base of the body whorl and up to the periphery then about 18–20 to the suture, on the penultimate whorl about 15 ridges.

Holotype. Height 3·4 mm. Breadth 1·7 mm.

This species is generally smaller than *leilae*, the average measurements for 5 paratypes being 3·4 mm. in height and 1·7 mm. in breadth.

There are several infra-specific taxa in this species which may be worth mentioning but not naming. The first (Biggs Colln. Reg. No. 1116 A). has the upper whorls brown and the lower one quite white but the sculpture is the same as in the species. The second is uniformly purple-brown coloured (Reg. No. 1116 B). There is a third "variety" which is entirely creamy-white (Reg. No. 858) and it is sometimes larger than the type of the species being 4·2 mm. in height by 2·1 mm. in breadth and having 8½ whorls.

Dahlakia jugosa sp. nov.

Characters generally as for the genus but whorls not uniformly rounded being wider below the periphery and furnished with somewhat irregular distinct longitudinal ridges; whorls 7½, white, sometimes flecked with brown and with fine ridges crossing the whorls latitudinally; suture only moderately deep; mouth pear-shaped and sharp.

Holotype. Height 3·4 mm. Breadth 1·6 mm.

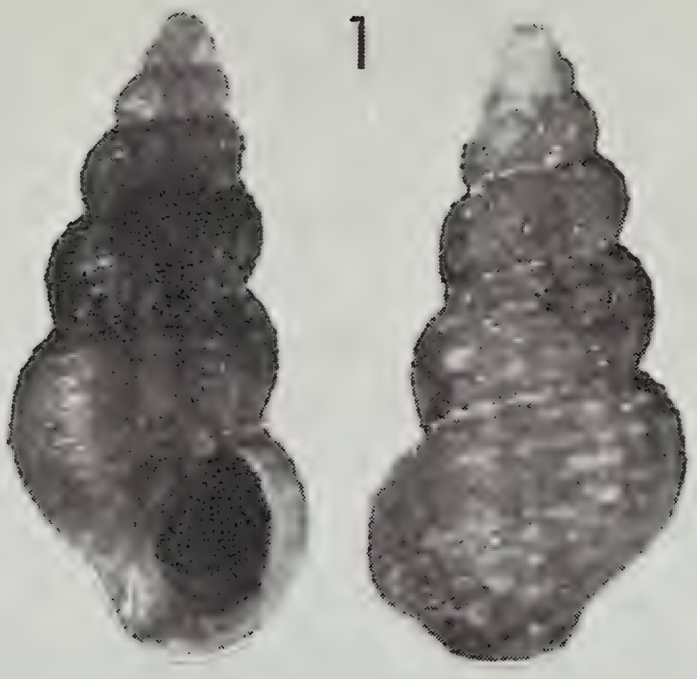
One of the paratypes is slightly larger, 3·5 mm. height by 1·7 mm. breadth. It is by no means as common as the other species described.

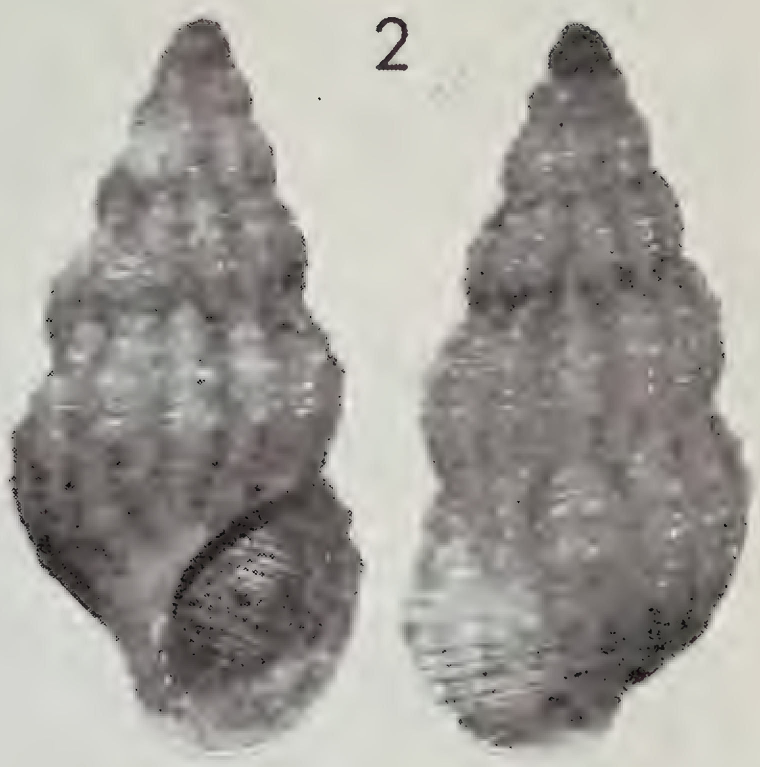
Dahlakia pirenelloides sp. nov.

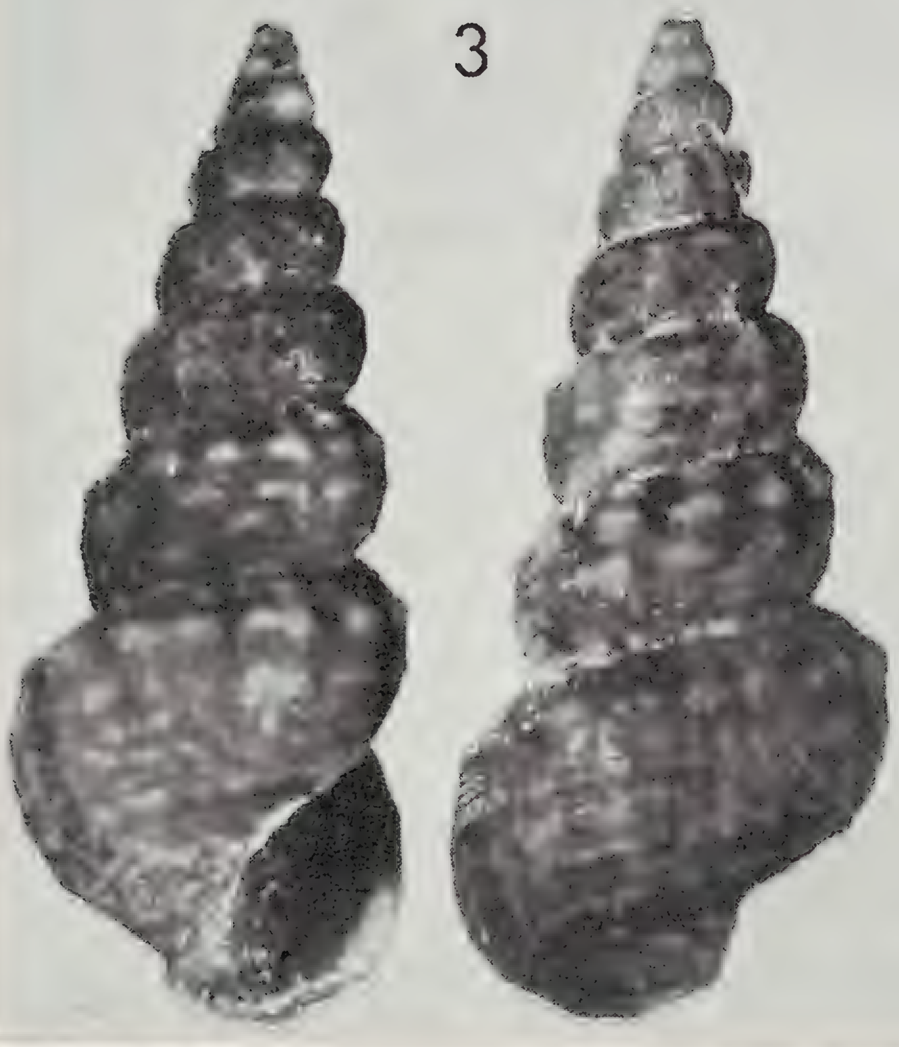
Characters generally as for genus, but shell much longer than two previously described species, in proportion to the width, whorls 9½ which increase slowly and regularly, three rows of nodules on each whorl of the spire; on the body whorl below the periphery two or three ridges having brown pigment between them, whorls somewhat broader below the periphery making the suture shallower; horn coloured but in worn examples coppery.

Holotype. Height 3·7 mm. Breadth 1·6 mm.

Plate VII







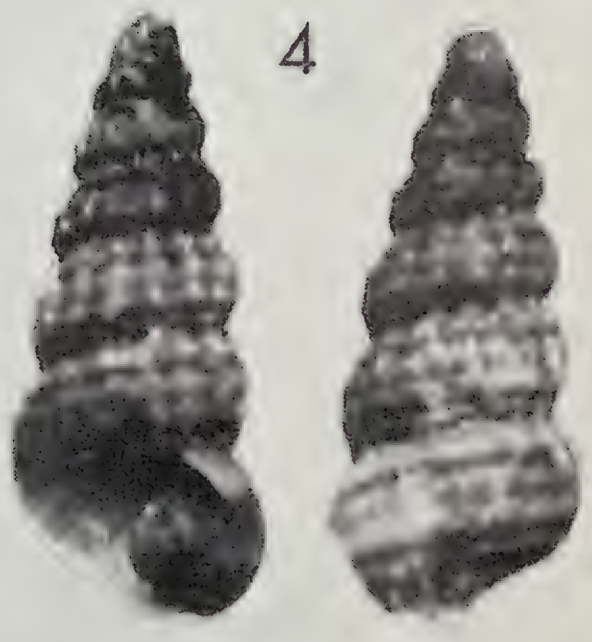


Fig. 1. *Dahlakia striata* sp. nov. Holotype.
Fig. 2. *Dahlakia jugosa* sp. nov. Holotype.
Fig. 3. *Dahlakia leilae* sp. nov. Holotype.
Fig. 4. *Dahlakia pirenelloides* sp. nov. Holotype.

This is a relatively uncommon species and is often worn with the apex damaged but seven of the paratypes appear to have 10 whorls. One paratype (Reg. No. 859 D. in my collection) measures 5·0 mm. in height by 2·2 mm. in breadth although the apical whorls are damaged.

The general appearance of this species bears some resemblance to juvenile examples of *Pirenella conica* Blainville, hence the proposed name, but it is very much smaller and lacks the sinuous mouth.

The proposed new genus may be widespread in the Red Sea as some shells amongst a number of small mollusca collected by me at Port Sudan in October 1931 and which have remained in my collection undetermined since then, bear a strong resemblance to some of the above described species.

All holotypes will be sent to the Zoological Institute of the Polish Academy of Science in Warshaw, paratypes to the British Museum (Natural History), The National Museum of Wales, The Manchester Museum, The Liverpool Museum, and in Biggs Collection.

My thanks are due to Mr. R. F. Cumberland for his efforts in photographing these small shells.

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J. Conch. *27*: 224 (1971)

REVIEW

Living Volutes a monograph of the recent Volutidae of the World by Clifton S. Weaver and John E. du Pont. pp. 400, 79 col. plates, numerous text-figures and maps. Published by the Delaware Museum of Natural History, Greenville, Delaware 19807, 1970. Price $55.

This beautiful book is, by reason of its high price (approx. £22) in the luxury class. This is a pity for it is a thoroughly workmanlike book dealing with a colourful, interesting and popular group of mainly tropical mollusks.

Every living "volute" has been treated of exhaustively; location of Holotype (when known), type-locality, range, habitat, dimensions, description of shell, details of anatomy and radula (again, when known), notes on varieties, discoverers of the various species, etc. etc. In the case of the rarer species the location of known specimens is quoted. Even now a number of species are known only from their Holotypes, though with the increased interest in shells everywhere some of the former rarities are becoming much less difficult to obtain. Such a species is *Volutoconus bednalli* (Brazier 1878), once considered very rare, but now being brought in by pearl-divers in ever-increasing numbers.

A conservative view has been taken of the many new species described of recent years and a number of them have been reduced to synonyms. For instance, in *Scaphella*, *S. gouldiana* Dall, *S. robusta* Dall, *S. bermudezi* Clench & Aguayo, *S. florida* Clench & Aguayo, *S. atlantis* Clench, and *S. cuba* Clench are all regarded as variants of *Scaphella* (*Clenchina*) *dohrni* (Sowerby III).

Every effort has been made to render the work as complete as possible, yet there is obviously much work still to be done in the group; repeatedly one reads "Animal and radula unknown", but conchologically this is a superb book. The colour plates, illustrating more than 200 species and subspecies, are excellent, especially those of the living animals.

Useful features not often found in a book of this sort are a glossary of terms used in describing volute shells and terms used in scientific nomenclature. There is a good and detailed index. A key to all the species would have been a valuable addition to the contents of the work.

It is unfortunate that the high price of this book, made necessary, no doubt, by the 79 coloured plates, puts it out of reach of many workers. Could not a cheaper version be produced, perhaps with fewer coloured plates or even black-and-white illustrations, for the impecunious but enthusiastic?

Nora F. McMillan

J. Conch. *27*: 225–234 (1971)

A REAPPRAISAL OF THE GEOGRAPHICAL DISTRIBUTIONS OF THE COCKLES, *CARDIUM EDULE* L. AND *C. GLAUCUM* BRUGUIÈRE

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(*Read before the Society*, 17 *October* 1970)

INTRODUCTION

Recently a group of morphological varieties has been separated specifically (Mars, 1951 and Høpner Petersen, 1958) from the common edible cockle, *Cardium edule* Linnaeus, and given the name *C. glaucum* Bruguière (1789) (Mars, 1951 and Bowden and Heppell, 1968). The name *C. lamarcki* Reeve, which was used by Høpner Petersen (1958), Tebble (1966) and others, has been equated to *C. glaucum* (Bowden and Heppell, 1968). Since *C. edule* and *C. glaucum*, which are the constituent species of the subgenus *Cerastoderma* Poli (the merits of retaining the various subgenera, recently elevated to generic level by Tebble (1966) and Bowden and Heppell (1968), within the genus *Cardium* Linnaeus will be expressed, cf. Russell, unpublished and Høpner Petersen, and Russell, unpublished), have been known by the same name, i.e. *Cardium edule* L., for many years (cf. Bucquoy, Dautzenberg and Dollfus, 1898, Winckworth, 1932 and Eisma, 1965) and also because important ecological differences between the species will be demonstrated (Russell, 1969), it was felt that a redefinition of the geographical distribution of each species was necessary.

THE ENVIRONMENTAL PARAMETERS WHICH LIMIT THE DISTRIBUTIONS OF THE SPECIES

Høpner Petersen (1958) and Muus (1967) suggested that it was the lowered salinity that was responsible for limiting the penetration of *C. edule* into some Danish fjords and into the Baltic, thus allowing *C. glaucum* to become the dominant *Cardium* (*Cerastoderma*) species. However, recent experimental work, supporting the view that *C. edule*, in contrast to *C. glaucum*, was unable to survive in physically stagnant (i.e. nontidal) water, has shown that *C. edule* was barred from a stagnant environment because of its inability to tolerate some substance liberated by the cockle itself. The inability of *C. edule* to survive in a nontidal environment having a normal salinity (30%) has been further substantiated by field transplantation experiments. It has been found experimentally that the tolerance of *C. edule* to stagnant conditions was further reduced by increasing the environmental temperature.

Further support will be given to the suggestion that a tidal environment is essential for the continued survival of populations of *C. edule* from the study of the probable environments in which populations of *C. edule* existed in the past, based on some records of subfossil shells of *C. edule*. The age of the sub-fossil shells of *C. edule* found in some of the Danish fjords, for example Roskilde fjord, where *C. edule* shells may be found together with oyster shells (neither species can be found living there today) indicated that these cockles were living some 10,000 years ago (Høpner Peterson, verbal communication). At that time, due to the absence of the English Channel current (the Straits of Dover were not, of course, open at this time), the unopposed North Sea current encouraged a strong tidal ebb and flow of the waters of the Skagerrak and Kattegat. Consequently those fjords opening into these waters would have been much more tidal and also more saline during this era. Some sub-fossil shells of *C. edule* have also been reported from the North African Sahara (Tournouer, 1878) and it is possible that these originated from a time when the penetration of tidal Atlantic waters into the Mediterranean basin was much greater, due to the far wider connection between the latter and the Atlantic Ocean, thus making the environment more tidal but not radically altering its salinity.

The environmental parameters responsible for limiting the distribution of *C. glaucum* are somewhat more obscure. Ecological studies showed that *C. glaucum* was often found in lagoons which received their water (via lock gates or by seepage through a shingle bank) from an estuarine shore on which *C. edule* was often very common but *C. glaucum* was seldom if ever found; *C. glaucum* was found living on intertidal foreshores only in very sheltered habitats, for example the landward ends of the Portsmouth, Langstone and Chichester harbour complex and the outer ends of some Danish fjords. Laboratory experiments have shown that exposure to air is not the major factor (Russell, 1969); the testing of a parameter such as exposure is very difficult, however, it is suggested that exposure may well be one of the factors limiting the habitat occupation of *C. glaucum* (see later).

THE DISTRIBUTION OF THE SPECIES

Tebble (1966) stated that *Cardium edule* "... has a wide geographical distribution from the western region of the Barents Sea and the Baltic to the Iberian Peninsula, into the Mediterranean, the Black and Caspian Seas and south along the coast of West Africa to Senegal ..." and that *C. glaucum* (under the name *C. lamarcki*) "... has a continuous distribution throughout Europe and in areas bordering the Mediterranean and Black Seas . . .", thus suggesting that both species have almost identical distributions. However, the large differences in the ecology of the species outlined previously conflict directly with such a suggestion; for example, the inability of *C. edule* to survive in waters not influenced by lunisolar tidal currents must surely exclude it from the major part of the Baltic, Mediterranean, Black, Caspian and Aral Seas.

The removal of the majority of the Baltic Sea from the recorded distribution of *C. edule* can be justified by reference to the work of Høpner Petersen (1958) and Muus (1967). There is, however, some confusion with regard to its presence in the western Baltic. Theede and Lassig (1967) reported that Eisma, who did not recognise the specific status of *C. glaucum* (Eisma, 1965), had confirmed that some samples of cockles collected from Keiler Bay were true *Cardium edule*; this was in conflict with the limit of their penetration into the Baltic suggested by Høpner Petersen (1958). However, it was reaffirmed that the penetration of *C. edule* into the Baltic appeared to be limited, at least in the southern Danish waters, to those areas influenced by Kattegat water (Russell, in preparation); it has since been reported by Høpner Petersen (verbal communication) that these *C. edule* populations in the western Baltic are somewhat transient.

The removal of the whole of the Mediterranean basin from the previously recorded distribution of *Cardium edule* can be justified from an examination of the relevant literature, dealing first with the central and eastern Mediterranean. It was apparent that those workers in this area who were primarily interested in the taxonomy of the local *Cardium* species used, for their figures or plates, specimens of *Cardium edule* taken, not from their own areas, but from the Channel, North Sea or Atlantic coasts. For example, Coen (1915) depicted examples of *C. edule* originating from 'Mercato di Parigi' and 'Amburgo', which are not Italian seaside towns, as one might suspect from a casual glance through his list of the origins of the cockles figured, but Paris market and Hamburg, respectively. Also it may be seen from the shell characteristics of the specimens figured by Poli (1791), Girscher (1940) and Kaltenbach (1943), depicting recent '*Cardium edule*' from Sicily, Egypt and the Bengazi area of Libya, respectively, that all these may in fact be referred to *C. glaucum*. Pallary (1912), in his work on the molluscs of the Mediterranean coast of Egypt, gave a list of six varieties of *C. edule*, all of which Mars (1951) referred to *C. glaucum*; he also found true *C. edule* in immense numbers in Lake Mareotis but only as separated shell valves. These latter are therefore considered to be subfossil and irrelevant to the present distribution of *C. edule*. The limit of penetration of *C. glaucum* along the Suez Canal towards the Red Sea can be seen from the results of the survey by Bavay and Tillier (1905), who stated that '*C. edule*' occurred commonly as far as Great Amer Lake where it was rare; thus it extended some $\frac{5}{8}$ of the 162 km. of canal. That the species referred to was in fact *C. glaucum* can be suggested from the fact that this author has seen cockles from Lake Timsah, approximately half way along the canal, which were clearly identifiable as *C. glaucum*.

Although lunisolar tides are very weak throughout the majority of the Mediterranean Sea, falling off rapidly from about 2m. at the Straits of Gibraltar to less than $\frac{3}{4}$m. at Tetouan, in the Gulf of Gabes the tidal range is much greater, up to 2·5m. at spring tides and even higher under certain meteorological conditions (Seurat, 1924). Thus it is possible that *Cardium edule* could be able to survive in this area, since it has been found living in some Danish fjords having a tidal range of about 0·5 m. (Russell, 1969). Unfortunately, recent literature on the molluscs of this area is sparse; however, Seurat (1924 and 1929) specified a number of varieties of *C. edule* in his comprehensive studies of the fauna of this area, mentioning, apart from *C. edule* L., the following varieties: *altior* B.D.D.., *lamarcki* Reeve, *paludosa* B.D.D., *quadrata* B.D.D., all of which Mars (1951) referred to *C. glaucum,* and *globulosa* Pallary, which from the description also seems referable to *C. glaucum.* Dautzenburg (1895) recorded *C. edule* var. *lamarcki* Reeve from this area as well as *C. edule* L., which he did not list in his earlier work (1883), in which only *Cardium lamarcki* was mentioned. This author has examined only two samples of cockles taken alive from this area (from La Skhira, just south of Sfax, and Bou-gara port, south of the Isle of Djerba) and no *C. edule* were found. Thus no evidence, apart from the use of the name *Cardium edule* and the presence of a single valve of a recent shell at Marseilles (Mars, 1951), has been found to indicate that *C. edule* exists in the central or eastern Mediterranean, although *C. glaucum* is obviously abundant throughout this area.

Many taxonomists, for example Milachewitch (1916) and Grossu (1961 and 1962), have reported *Cardium edule* L. from the Black, Caspian and Aral seas. However, they did not recognise *C. glaucum* specifically and it can be seen that both authors noted that it was not the typical form (i.e. true *C. edule*) but many of its varieties that were found throughout these waters. The large majority of these varieties can be referred to *C. glaucum;* for example, *Eichwaldi* Reeve, *lamarcki* Reeve, *Batesoni* B.D.D. and *quadrata* B.D.D. are so referred by Mars (1951) and from the figures of Milachewitch (1916, Plate 7, nos. 7–14), depicting the varieties *nuciformis* Mil., *maeotica* Mil., *picta* Mil., and *intermedia* Mil., I refer all these varieties to *C. glaucum.* In fact Milachewitch (1916) noted (without a definite reference) that Monterosato was of the opinion that only *C. glaucum* and not *C. edule* occurred throughout the Mediterranean but, apparently, did not accept this view himself, since he listed his varieties under the name *C. edule* L.

The western Mediterranean and its Atlantic approaches will be considered in two parts, dealing first with the southern shore formed by the Algerian and Moroccan coasts. Of the many varieties of *Cardium edule* reported from Algeria only var. *libenicencis* Brusina, which was reported from Bone by Bucquoy, Dautzenberg and Dollfus (1898), and var. *regularis* Pallary, which was reported by the author (1900) from Oran and La Mactra, were referred by Mars (1951) to true *C. edule.* Pallary (1900), however, stated that the type (i.e. true *C. edule*) did not exist along the Algerian coast. Pasteur-Humbert (1962), although under the name *C. edule,* depicted an example of this cockle from the Moroccan coast which can only be classified by this author as *Cardium glaucum.* Pasteur-Humbert made no mention of any of the varieties of the species and thus very little reliance can be placed on his statement that *C. edule* was common along the Mediterranean coast of Morocco. However, some cockles, the description of which fits *C. edule* rather than *C. glaucum,* were reported from the Bay of Tangier by Pallary (1902). He also indicated which of the varieties of *C. edule* were to be found in this area, for example var. *umbonata* and var. *quadrata*, both of which Mars (1951) referred to *C. glaucum*. Pallary (1902) also noted the presence of cockles intermediate between the type and the var. *lamarcki* (= *C. glaucum*); thus it may be suggested that mixed populations of *Cardium edule* and *C. glaucum*, possibly containing some intermediates, were present in these semitidal waters, a feature already noted in such waters around the Kattegat coast of Denmark.

Little information can be gleaned from the Spanish workers, with regard to the distribution of these species along the northern shore of the entrance to the Mediterranean. Hidalgo (1917), who made a comprehensive study of the molluscs of the Spanish coast, unfortunately recognised neither the specific status of *Cardium glaucum* nor any of the "varieties of *C. edule*". Thus it is possible to state only that one or both species were common along this coast; however, of the three samples of recent material examined personally those from Barbate and Faro, on the Atlantic coast of Spain and Portugal, respectively, contained only *C. edule* whilst that from Almeria, on the Mediterranean coast, contained only *C. glaucum*.

Information regarding the southern limits of the two species is sparse but it may be assumed from the reports of Pasteur-Humbert (1962) and Nicklès (1950), who both stated that *C. edule* was common on the Mauretanian coast, that they extend as far as the boundary of the Maurentanian region, which Ekman (1935) put at Capo Blanco. The Canary Islands and Madeira are usually included in the Mauretanian region (Ekman, 1935) and an estimated 63% and 70%, respectively, of their molluscan faunas were Lusitanian species (MacAndrew, 1852). However, neither *C. edule* nor *C. glaucum* have been reported either in the early surveys of the Canaries by Dautzenberg (1891), Odhner (1932) and Fischer (1946) or by Duffus and Johnston (1969) in their recent survey of Lanzarote, one of the two islands nearest to the West African coast (less than 100 miles). Also, despite earlier reports of its presence (d'Orbigny, 1839), Watson (1897) positively excluded *C. edule* from his list of the marine molluscs of Madeira. It must be assumed that *C. glaucum* is also absent from these islands.

The northern limits of the species are also rather difficult to determine accurately. Høpner Petersen (1968) placed the limits of both *C. edule* and *C. lamarcki* (= *C. glaucum*) on the European mainland at 70° 30′ North, which approximates to the northern tip of Norway. Ockelmann (1959) put the northern limit of *C. edule* as 'north of Lofoten'. Both species appear to be absent from the Faroes (Høpner Petersen, 1968) and Greenland (Ockelmann, 1959). Ockelmann (1959) also excluded Iceland but Høpner Petersen (verbal communication) has since reported that *C. edule* has been found there in small numbers. Zhadin (1952) reported that *C. edule* occurred in the White Sea, which runs south to a position some 6° of latitude south of the tip of Norway. However, he did not mention *C. glaucum* or any of the varieties of *C. edule*. It would thus be of great interest to determine whether only one or both species can be found along the northwest coast of Russia and also their limit of eastward penetration.

Bowden and Heppell (1968) stated that they had identified *C. glaucum* from the Outer Hebrides and that this was the first record of this species from Scotland. *C. edule* is, of course, common around the Scottish coast (Stephen, 1932). Nicol (1938) noted the absence of cockles from the brackish lochs of Orkney, where one might have expected to find *C. glaucum*, although *C. edule* was abundant just outside these lochs; *C. edule* was also reported from Orkney by Winckworth (1928). Winckworth (1932) equated the "Ball's variety" of *C. edule* (originating from South Arran) in Forbes and Hanley (1853) to *C. edule beltica* Reeve (= *C. glaucum*) and this and the recent report of its presence by Boyden (personal communication) would appear to be the only reports of *C. glaucum* from Ireland. Tebble (1966) suggested that the Wash was the northern limit of the latter species on the east coast of England. The only positive report of *C. glaucum* from the west coast of Norway would appear to be that of Tulkki (1961), who reported "*C. lamarcki*" from the two brackish bays of Vagsbopollen and Tellnespollen, near Bergen. A northern limit of *C. glaucum* in this region would seem to be much more in accordance with its apparent northern limit in the British Isles.

DISCUSSION

From a comparison of the true distributions of *Cardium edule* and *C. glaucum* outlined above and their previously recorded distributions, the origin of the misunderstanding with regard to both their taxonomic status and their distributions can now be demonstrated. The problems of specific divisions within the subgenus *Cerastoderma* originate from the eighteenth century. Poli (1791 and 1795) ascribed a cockle found commonly around the coast of Sicily to *Cardium edule* L.; unfortunately this cockle was *C. glaucum*, this fact may been seen clearly from the beautifully coloured figures in his earlier work (1791). Some of the later conchologists, for example Costa (1829), justified their use of the name *C. edule* for these Mediterranean cockles by reference to the works of Poli, but the majority described them under a variety of specific names, for example Philippi (1836) used *C. rusticum* Chemnitz (the nomenclatural history of *C. glaucum* and its junior synonyms will be dealt with more fully by Russell). It was probably this confusion within the nomenclature and taxonomy that led such eminent conchologists as Forbes and Hanley (1853) and Bucquoy, Dautzenberg and Dollfus (1898) to conclude that only *Cardium edule* L., with its many morphological varieties having an extensive European distribution, should be recognised specifically. This view was perpetuated, with some notable exceptions such as Coen (1915), Chavan (1945) and Mars (1951), until quite recently. Emery and Stevenson (1957), Caspers (1957) and Zenkevich (1957) all referred to *C. edule* in their ecological studies of the bottom fauna of the Sivash (a hypersaline lagoon opening into the Sea of Azov), the Black and Azov seas and the Caspian and Aral seas, respectively. That these cockles should be referred to *C. glaucum* has been suggested earlier.

The apparent ability of *C. edule* to tolerate extremes of both high and low salinity has added to the confusion; for instance Havinga (1922) reported *C. edule* from the southern end of the former Zuiderzee in a salinity of less than

1°/₀₀ Zenkevitch (1947) suggested an upper limiting salinity of about 75°/₀₀ for this species in the Sivash and Scordia (1926) reported that survival of *C. edule* in Italian waters having a salinity greater than 100°/₀₀. These reports must, in the light of the present work, be referred to *C. glaucum*. Høpner Petersen (1958) suggested that *C. edule* was a relatively stenohaline species, compared with the euryhaline *C. glaucum*, and that this was the major factor responsible for limiting its distribution in Danish waters; this was later supported by Muus (1967) but has been rejected by this author. Futhermore, it is suggested that the stenohalinity of *C. edule* is only apparent, it being imposed not by the inability of the species to tolerate a wide range of environmental salinities but by the fact that neither very brackish nor very hypersaline waters ever exhibit a large enough tidal flow to support a reproducing population of *C. edule*. Thus the extent of the euryhalinity of these species would seem to be important only in relation to studies on their physiology as opposed to their distributions.

From the positive reports of *C. edule* and *C. glaucum* from northern Europe it would seem possible that *C. edule* may well extend further north than *C. glaucum*. Also, it has been reported by Boyden (verbal communication) that *C. edule* spawned before *C. glaucum*, when both species occupied the same area of the river Crouch estuary. Thus it is suggested that *C. glaucum* may require a higher water temperature for breeding and probably originated in a warm water area. Ecological evidence suggests that water temperatures as high as 20°C. may be required for *C. glaucum* to breed successfully (Russell, in preparation). Thus, it may be concluded that the habitat occupation of breeding populations of *C. glaucum* is limited by the extent to which the water temperature rises in summer. Since any European water mass attaining such summer temperatures would, of necessity, have been sheltered and semitidal (or even nontidal) and it is known that *C. edule* shows a decreasing ability to withstand a stagnant environment with increasing temperature, then it must be concluded that the present overlap in their geographical distributions, to the extent of mixed populations in some areas, is due to physical convergence, following some change which resulted in a breakdown of the separation of the different environments occupied during their speciation. The dispersion of the species was facilitated by their planktonic larvae being easily transportable by coastal currents. Both species were notable by their absence from offshore island groups*, for example the Canaries and the Faroes, but in the less remote Orkney *C. edule* was present whereas *C. glaucum* was absent from apparently suitable environments (Nicol, 1938); this may well be a reflection of the shorter planktonic life of *C. glaucum* larvae (Kingston, verbal communication). It is well known that *C. edule* larvae form an important constituent of the plankton in coastal waters (Lebour, 1939 and Creek, 1960) and the transient populations of *C. edule* in the western Baltic could be the result of the settlement of groups of larvae carried from the Kattegat by the deeper more saline currents which flow into this area of the Baltic. However, it would not seem reasonable to account for the presence of *C. edule* in Iceland by such a theory of larval transport and the possibility of introduction must not be excluded.

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* But *C. edule* occurs in Shetland.—Ed.

Finally, it is of interest to note that the presence of *Cardium glaucum* in both the Baltic and the Mediterranean seas, with the virtual exclusion of *C. edule*, follows the general zoogeographical pattern of many long established molluscan species. Ekman (1935) referred to the statement of Sars (1879), who suggested that 68% of all Scandinavian molluscs were to be found in the Mediterranean. This may be a pointer towards the further investigation of the limiting environmental factors responsible for delimiting the distributions of other marine molluscs, in the light of the influence of a tidal environment on the distributions of these two closely related *Cardium* species.

GENERAL CONCLUSIONS

1. *Cardium edule* has a continuous geographical distribution throughout only those European waters which exhibit lunisolar tidal flow, thus being limited to estuaries bordering the Atlantic, English Channel, Irish Sea, North Sea, Norwegian Sea and probably the Arctic Ocean. It is also found in the outer ends of fjords opening into the Skagerrak and Kattegat. It does not, however, penetrate the central or eastern Baltic or the Mediterranean to any marked extent.

2. *Cardium glaucum* has a continuous distribution throughout the Mediterranean, Black, Caspian and Aral Seas and also in the Baltic. However, its distribution over the rest of the European coastline is discontinuous, being found in semitidal sheltered fjords opening into the Skagerrak and Kattegat, isolated lagoons, the most sheltered parts of estuaries and the very sheltered foreshore of the Danish Wadden Sea.

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RISSOA VIOLACEA DESMAREST, *RISSOA LILACINA* RÉCLUZ, *RISSOA RUFILABRUM* ALDER AND *RISSOA PORIFERA* LOVÉN AND THEIR DISTRIBUTION IN BRITISH AND IRISH WATERS

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(*Read before the Society*, 17 *October* 1970)

ABSTRACT

An examination of specimens from the *Rissoa violacea–R. lilacina–R. rufilabrum–R. porifera* group has revealed that *R. violacea* is a separate species and is not British. The others are more closely related and can be regarded as more or less distinct species. *R. porifera* should be added to the British list.

I. INTRODUCTION

Rissoa violacea Desmarest, *Rissoa lilacina* Récluz and *Rissoa rufilabrum* Alder have been confused, and one aim of this paper is to end this confusion. Many samples of specimens, kindly lent by private persons and by museums, bearing labels indicating that they belong to these species have been examined. It appears that a considerable proportion of this old labelling may be erroneous. The confusion seems to have arisen in Britain because from the descriptions in Forbes and Hanley (1853 p. 100) and Jeffreys (1867 p. 33) it is not always easy to decide whether the names refer to the distinct and definite forms or whether they are descriptions embracing more than one species. Winckworth (1932 p. 222) regarded *R. lilacina* as the correct name for all the British forms, and referred to Forbes and Hanley's description of *R. rufilabrum* and Jeffreys' description of *R. violacea*. Nordsieck (1968 p. 54) presented the three names as three separate species, and he regards *R. violacea* as being Mediterranean. It is not easy in practice to distinguish between *R. lilacina* and *R. rufilabrum* using his descriptions. He considers *R. porifera* to be a separate species. In all collections seen by me this has been named as a variety, usually of *R. violacea*, and has been regarded as such by Jeffreys (1867, p. 33), who also has mentioned a further variety, *R. violacea* var. *ecostata*. Specimens bearing this name occur in several collections. It will be shown that this cannot be separated from *R. porifera*.

From examination of samples it seems probable that, apart from their confusion with each other and closely related species, *R. violacea*, *R. rufilabrum* and *R.*

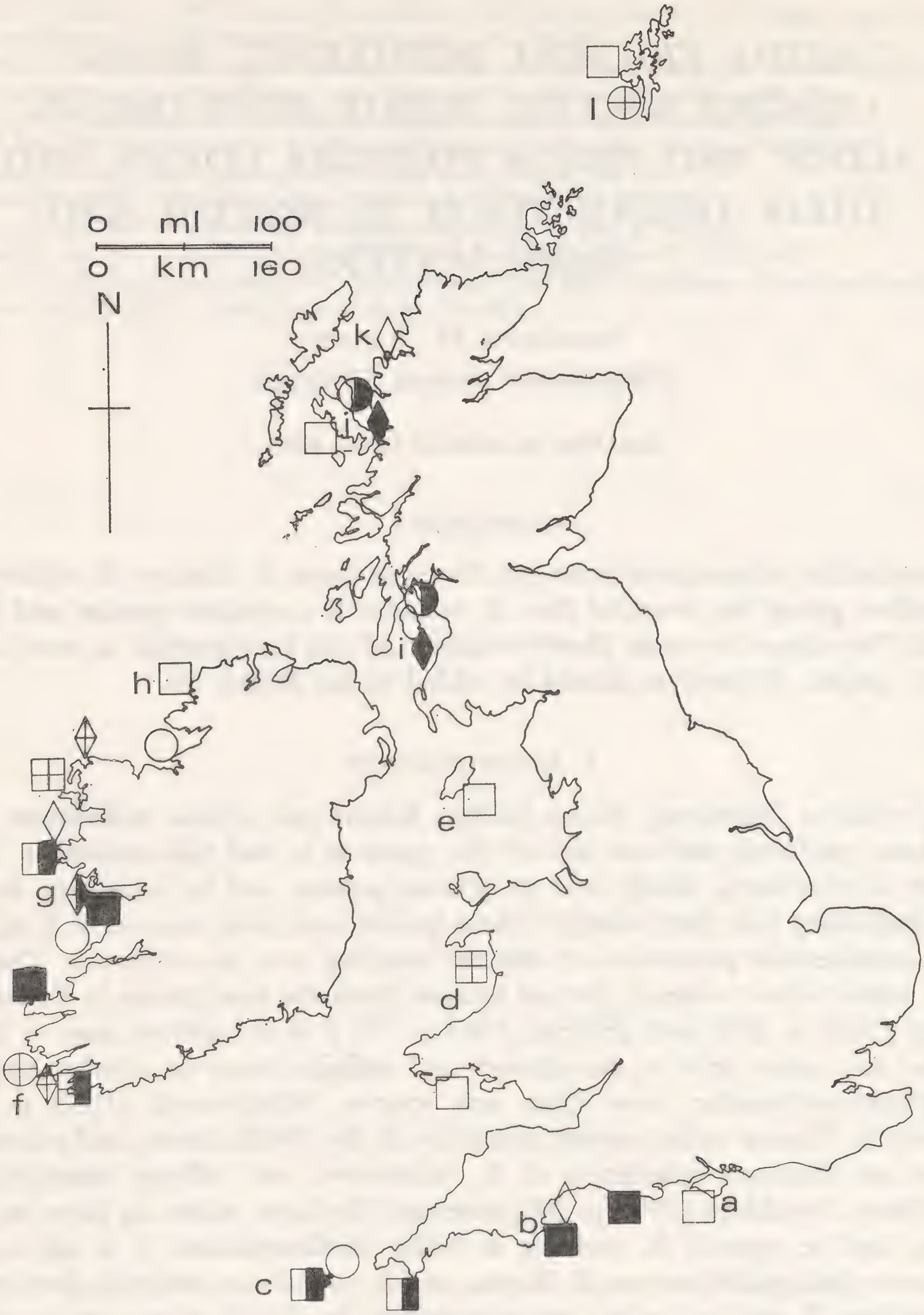


Fig. 1.

lilacina are most likely to be confused with *Turboella parva* (da Costa) which may be distinguished from these by its total lack of punctation, its sharper longitudinal ribs, if any, and the comma-shaped mark on the last whorl just behind the lip, or failing that by the pinkish-violet apex. *Rissoa membranacea* (Adams), which is rather like *Rissoa ventricosa* Desmarest, boasts a tooth on the columella, a large almost ear-shaped mouth, and is never punctate.

All the European species of *Rissoa* S.G. *Persephona* Leach (Nordsieck, 1968 p. 54) and *Rissoa* s.s are described. As shown below in the synonymy *Persephona* is preoccupied and all the species are for the moment placed in *Rissoa* s.s. The chief distinguishing character of this genus of the Rissoidea is fine punctate or reticulate ornament, especially noticeable on the last whorl. It is not always present in some of the species. There is considerable variety in shell colour, shape and type of longitudinal ribs, and a strong labial rib is present. Characters used to distinguish species and varieties include the degree of definition of the suture, the apical angle, the number of longitudinal ribs per whorl and the number of whorls bearing ribs, shape and heaviness of the peristome area, and the colour of the shell. Measurement of the apical angle proved a much more reliable method of gauging the rotundity of the shell than the determination of its width in relation to its height, the latter ratio not accurate if the apex be missing and also depending on the original bluntness of the apex. Certain identification was not always possible in the case of immature specimens. A total lack of ribs could indicate immaturity alone, or could be a permanent characteristic. Shells were regarded as reasonably mature for the purposes of identification when there was a ribless portion on the last whorl of a ribbed specimen or when the labial rib was present and growth thus more or less complete.

Five forms, not including *R. guerinii* Récluz, have been recognised from British and Irish waters. On the basis of the above characteristics they have been divided into three species and two varieties. *R. lilacina*, *R. rufilabrum* and *R. porifera* are the species. There is a form intermediate between *R. lilacina* and *R. rufilabrum*, and a rather more distinct variety, *R. rufilabrum* var. *paucicostata*, between *R. rufilabrum* and *R. porifera*.

The distribution of the British and Irish species has been estimated. This distribution is to some extent paralleled by a change of form, *R. lilacina* being to the south and west, *R. rufilabrum* somewhat ubiquitous but most typical of western Scotland, and *R. porifera* sparse in Ireland, increasingly common in western Scotland and the usual form in Shetland (Text-fig. 1). No distinction has been made between specimens collected before and after 1900. Many did not have dates. Of the others, the bulk were collected before 1900, but examples gathered more recently indicate that the general distribution has not changed.

II. SYNONYMY

Rissoa Desmarest 1814.

Type species *R. ventricosa* Desmarest 1814. The references to Fréminville as quoted by Neave (1940, p. 77) and Coan (1964, p. 166) are *nomina nuda*.

Rissoa S. G. *Persephona* Leach 1852 in *A synopsis of the Mollusca of Great Britain*, p. 189 non *Persephona*–Crustacea Leach 1817 in *Zoological Miscellany* **3**, 22. Following Coan (1964, p. 166) *Persephona* being preoccupied in Crustacea, the sub-genus *Persephona* is not a valid name and the species within this sub-genus are placed in *Rissoa* s.s.

R. violacea Desmarest 1814 in *Bull. Soc. philomath. Paris*, p. 8 and pl. 1, fig. 7.
The references to Fréminville earlier than Desmarest 1814 as quoted by Neave (1940, p. 77) are *nomina nuda. R. violacea* Desmarest in Nordsieck (1968, p. 54).

R. lilacina Récluz Jan. 1843 in *Revue zool.* **6** : 6.
R. violacea in Jeffreys (1967, **4** : 33).
R. rufilabris Hanley *in* Thorpe. *British Marine Conchology*, April 1844, p. xl.
R. lilacina in Nordsieck (1968, p. 54).

R. rufilabrum Alder May 1844 in *Annal. nat. Hist.*, **13** : 325 and pl. 8, figs. 10 and 11.
R. rufilabrum in Forbes and Hanley (1853, **3** : 106). This description refers to *R. rufilabrum* but has overtones of *R. lilacina*, which, however, is said to be different.
Alvania rufilabrum Leach is in *MSS* only, the description was published by Alder.
R. rufilabrum in Nordsieck (1968, p. 54).

R. porifera Lovén 1846 in *Ofvers. K. vetenskAkad. Förh. Stockh.*, **3** (5), p. 156.
R. violacea var. *ecostata* in Jeffreys (1867, **4** : 33).
R. violacea var. *porifera* in Jeffreys (1867, **4** : 33).
R. porifera in Nordsieck (1968, p. 54).

III. KEY

This key is to all species described in the text, and includes for convenience *R. membranacea* which belongs to another sub-genus.

1. Shell without longitudinal ribs 2
– Shell with longitudinal ribs or strong reticulate ornament 3
2. Shell lacking ornament or with growth lines only : *R. membranacea* (p. 241)
– Regular pattern of pits or punctations present on the lower whorls : *R. porifera* (p. 246)
3. Ornament reticulate, or with strong spiral striae imposed upon longitudinal ribs 4
– Ornament not reticulate, spiral striae fine or fairly fine or absent 5
4. About 10 longitudinal ribs per whorl, spire pointed : *R. frauenfeldiana* (p. 242)
– About 20 longitudinal ribs per whorl, spire blunt : *R. aurantiaca* (p. 242)
5. Longitudinal ribs on at least four whorls 6
– Longitudinal ribs on less than four whorls 10
6. 8 longitudinal ribs per whorl : *R. decorata* (p. 243)
– 10–14 longitudinal ribs per whorl 7
– 16 longitudinal ribs per whorl 9

Plate VIII

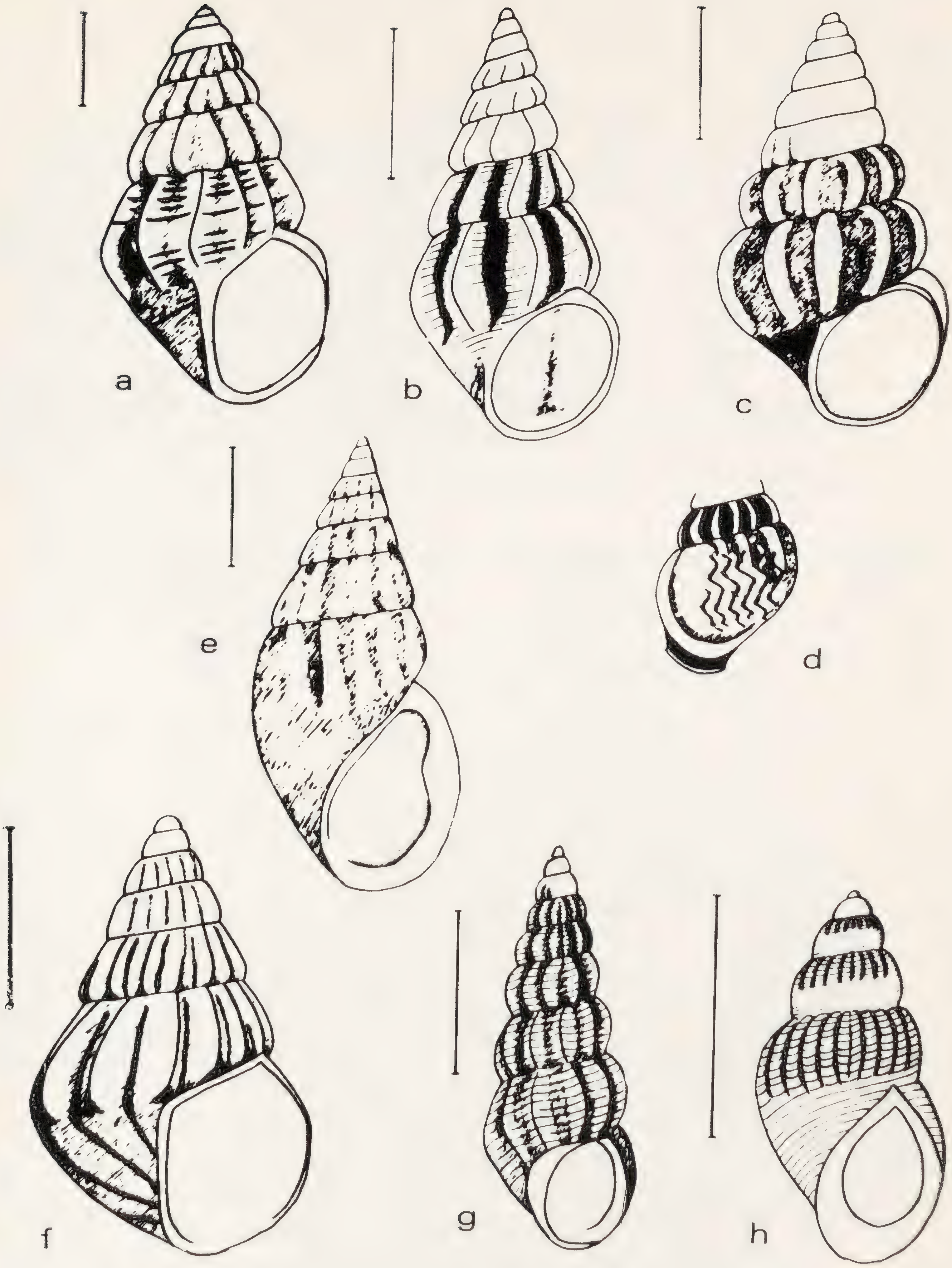
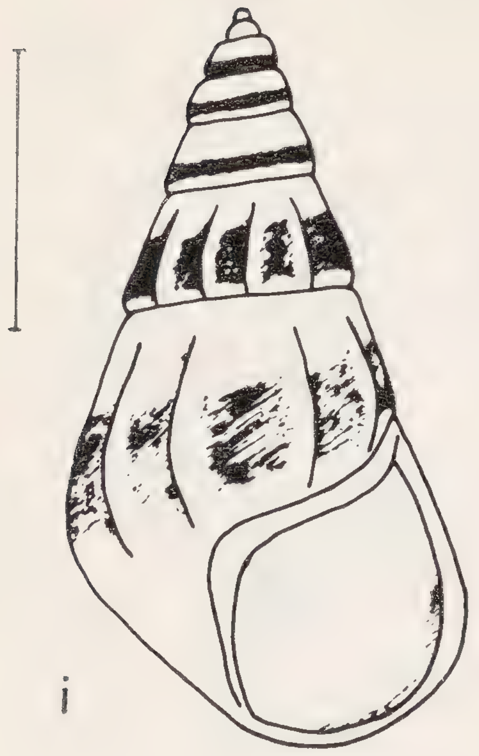


PLATE IX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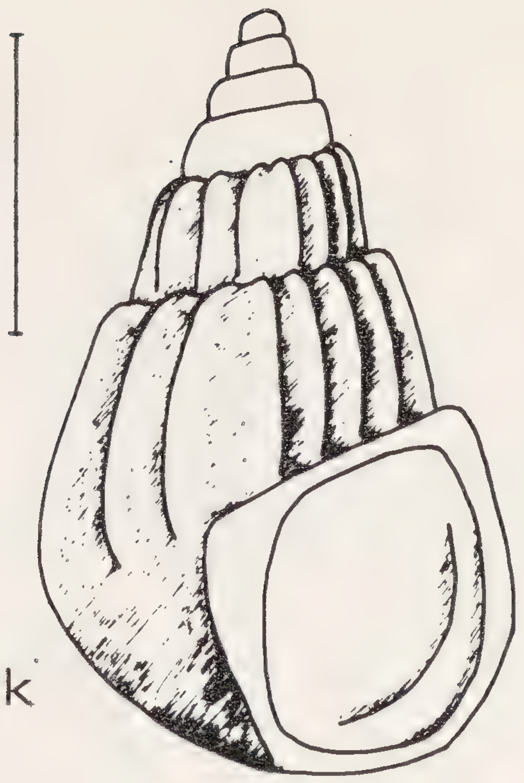
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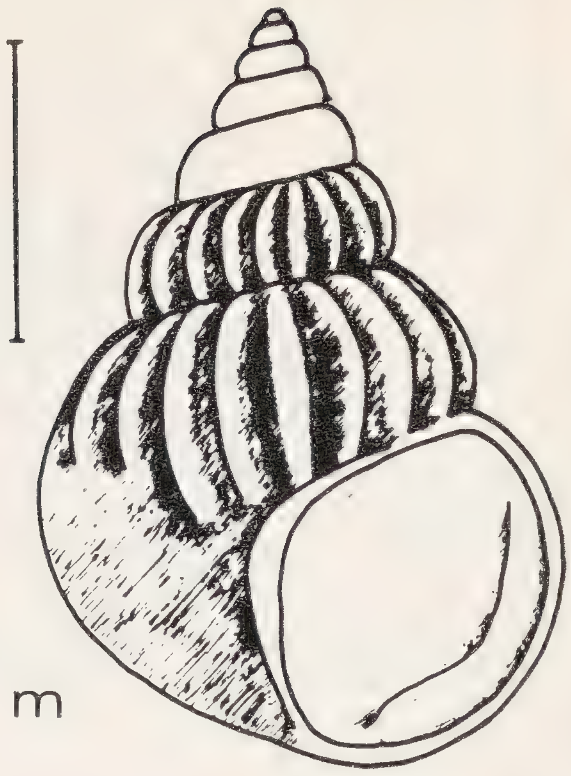
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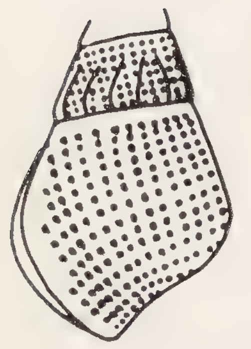
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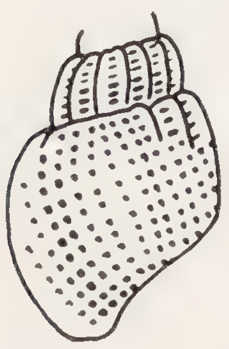
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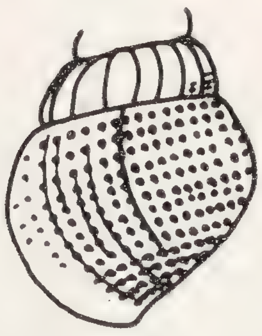
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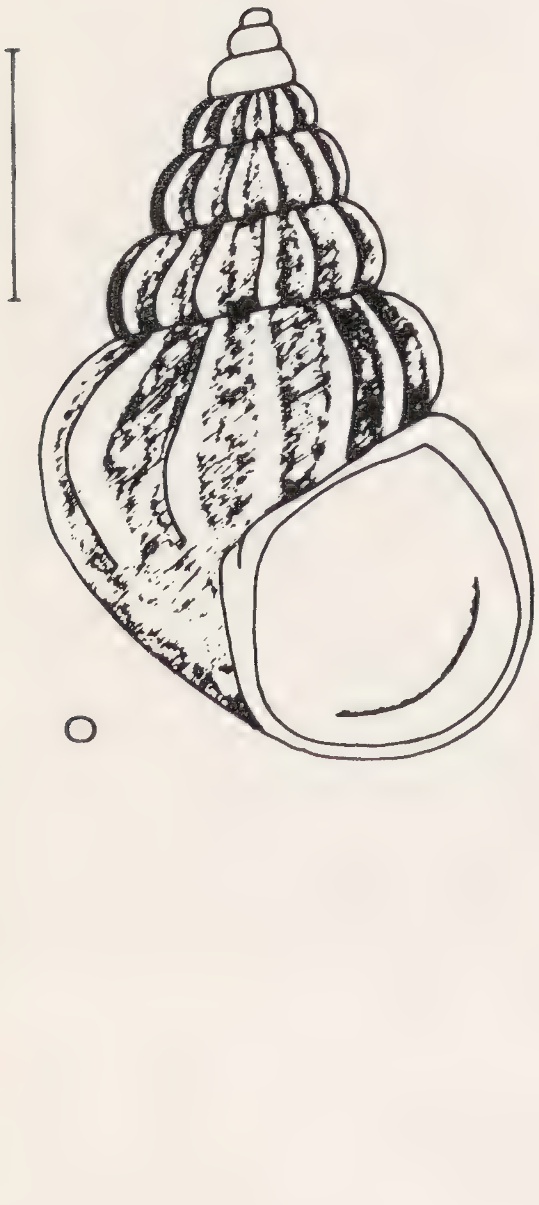
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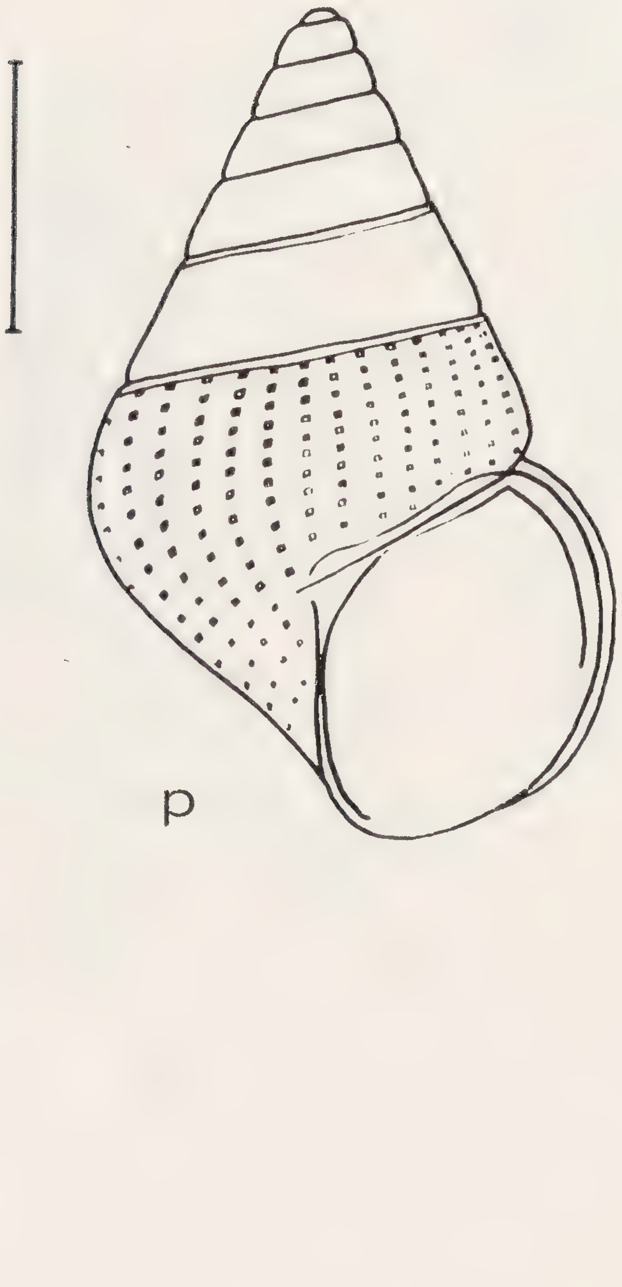
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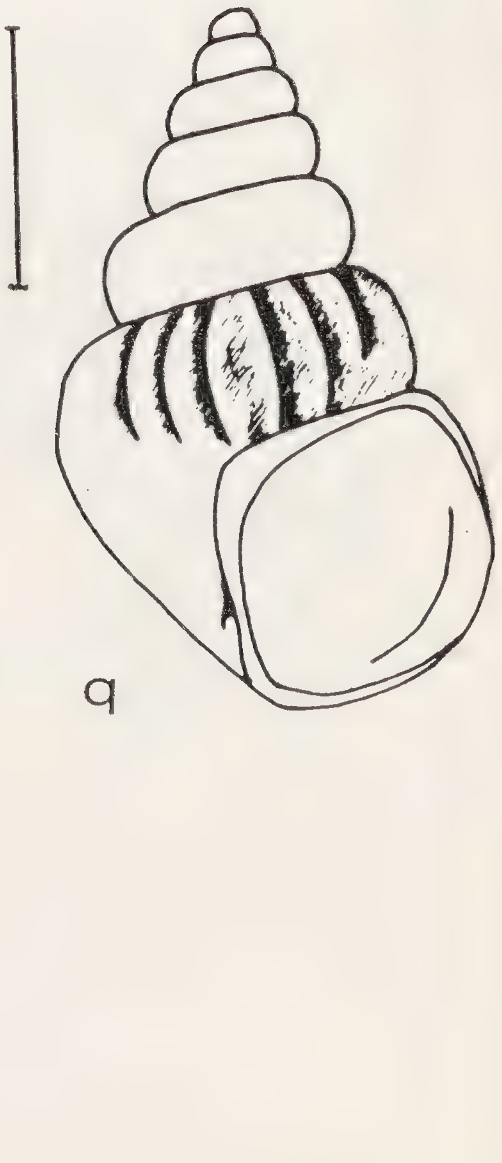
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7. Suture slight, ribs low, mouth pear-shaped, narrow above: *R. ventricosa* (p. 241)
– Suture moderate to deep 8
8. Higher whorls somewhat overhang the next at the suture, mouth oval, shell white with colour markings: *R. variabilis* (p. 242)
– Whorls rounded, mouth round, shell green with colour markings: *R. splendida* (p. 243)
9. Shell wide at the base, thick: *R. plicatula* (p. 242)
– Shell club-shaped, generally not thick: *R. membranacea* (p. 241)
10. Longitudinal ribs only occur on part of one whorl: *R. rufilabrum* var. *paucicostata* (p. 246)
— Longitudinal ribs occur right round at least one whorl 11
11. 10 longitudinal ribs per whorl 12
— More than 10 longitudinal ribs per whorl 13
12. Suture deep, mouth round: *R. guerinii* (p. 243)
13. Suture very slight, mouth pointed above: *R. violacea* (p. 244)
— Suture moderate or deep 14
14. 11–15 longitudinal ribs per whorl, mouth angled at the top: *R. lilacina* (p. 244)
— At least 16 longitudinal ribs per whorl, mouth rounded at the top: *R. rufilabrum* (p. 245)

IV. DESCRIPTION AND DISTRIBUTION

It was quickly realised that because of the confusion regarding *R. violacea*, etc., these species could not be altogether treated in isolation and some reference should be made to the related species. The non-British forms are only described, and varieties of these are not distinguished. Few specimens of *R. plicatula* and *R. aurantiaca* were obtained and for *R. frauenfeldiana* the only reference was Brusina's (1866, p. 22) original description and plate. The most important diagnostic characters of each species in italics.

R. membranacea (Adams). Height 9 mm. Shell rather smooth and *club-shaped* in outline. Apex sharply pointed or blunt. About 8 rather flattened whorls, *suture slight*. Apical angle 40°–45°. About *16 longitudinal ribs per whorls*, on most of the whorls, or no ribs at all. The longitudinal ribs do not occur on the last half of the body whorl. *Mouth oval, narrower above, very large.* Labial rib present but not thick. *A tooth or fold on the columella usually present.* Punctations and spiral lines absent, but growth lines may be present. Colour horny to green, shell somewhat transparent.

Mediterranean to south and west Britain and Ireland.

R. ventricosa Desmarest. (Pl. Ie) Height 9 mm. Shell rather *smooth in outline*, fairly *tall and club-shaped*, apex pointed, with about 8 flattened whorls. *Apical angle 42°–44°. Suture slight.* About 12 longitudinal ribs per whorl,

not usually on the top two or three whorls. The longitudinal ribs do not occur on the last half of the body whorl. Fine spiral striae present on all but the body whorl, and punctations usually present on the body whorl. Labial rib thick with possibly *a prominence on the inside of the outer lip near the top. Mouth pear-shaped, narrow at the top.* Peristome reflected over the body whorl and the columella. Shell yellowish-green, opaque or semi-transparent with a paler peristome area and labial rib. Peristome may be edged with mauve or red. Worn specimens white, semi-transparent, glossy, with a mauve spot on the columella and possibly a red apex. A rather variable species, similar in form to *R. membranacea.*
Mediterranean.

R. plicatula Risso. (Pl. If) Height 7 mm. Shell somewhat smooth in outline, *conical, but not keeled,* with 6–7 rather *flattened whorls which overhang the suture.* Apical angle about 48°. *Suture fairly slight.* About *16 longitudinal ribs per whorl, on at least four whorls.* Fine spiral striae present but no punctations. Labial rib found only on very mature specimens. Mouth roundish, either rounded or angled at the top. Colour white or yellowish, worn specimens dull. Brownish-red streaks occur between the ribs.
Mediterranean.

R. frauenfeldiana Brusina. (Pl. Ig) Height 5 mm. Tall-spired, about 2½ times as high as broad, apex pointed. 8 rounded whorls, *suture deep.* About *10 longitudinal ribs per whorl,* on all but the topmost whorls and *extending right round the body whorl.* Thick labial rib. Mouth rather small, round. *Strong spiral striae.* Peristome reflected over the body whorl and columella. Shell glassy-white with a violet peristome.
Adriatic.

R. aurantiaca Watson. (Pl. Ih) *Height 3 mm.* Shell somewhat cylindrical with a *blunt apex,* apical angle 35°–45°. 5–6 rounded whorls, suture deep. About *20 longitudinal ribs per whorl, barely extending to the periphery.* In some specimens the ribs are well-marked, in others scarcely more prominent than the very strong spiral line or ribs which give the shell a *reticulate appearance.* Labial rib present. Mouth roundish. Colour yellow, pale orange or buff.
Canaries.

R. variabilis (Mühlfeld). (Pl. Ia) Regarded as the largest *Rissoa,* but none seen which were clearly larger than *R.ventricosa* or *R. membranacea.* Height 9 mm. Shell rather conical, sharply pointed. Apical angle variable, averaging 40°. About 8 *whorls, overhanging the suture, suture moderate. 10 strongly sculptured longitudinal ribs per whorl,* on all whorls except the last part of the body whorl. *Well-incised spiral striae and very fine longitudinal striae* are present rather than a distinct punctate pattern. Thick labial rib. Mouth roundish-oval. Peristome reflected over the body whorl and columella. Shell white, pinkish or faintly violet on colour, semi-transparent, with *brownish-red spiral lines and/or spiral rows of dots.* There may be *a purple spot at the top of the columella.*

Mediterranean.

R. decorata Philippi. (Pl. Ib) Height 6 mm. Shell noticeably tall in proportion to its width, apex pointed. *Apical angle about 35°.* Whorls 8 in number, *overhanging the suture which is moderate to deep.* Only *8 very pronounced longitudinal ribs per whorl.* Spiral striae, well-incised between the ribs, and punctations are present, most visible on the body whorl. Labial rib thick and opaque. Mouth round-oval, peristome area much thickened and reflected over the body whorl and columella. Colour glassy-white with *violet-brown longitudinal stripes between the ribs. The stripes may continue as comma-shaped markings on the body whorl below the periphery, and they have clear-cut margins.* Apex and mouth area white. Distinguished from *R. parava* by the presence of strong spiral lines, punctations and sharper ribs.

Mediterranean.

R. guerinii Récluz. (Pl. Ic, d) Height 6 mm. Shell rather similar in outline to *R. decorata.* Apex pointed. *Apical angle 37°–43°. 8 whorls* which are rounded and *do not overhang the suture, which is deep. 10 longitudinal ribs per whorl.* Spiral lines present but much finer than those of *R. decorata.* These lines may be punctate. Labial rib thick. *Mouth round, with a thin margin protruding beyond the labial rib. Peristome more or less entire,* and only very slightly reflected onto the body whorl. Colour very variable, basic shell colour being white, buff or greenish, dull or transparent. There may be brown longitudinal streaks between the ribs, with diffuse margins. More rarely there is a *highly characteristic brownish-red zigzag pattern* all over, perhaps worn across the ribs. Peristome often edged with violet. Apex also may be violet. Apart from the colour, this species seems to be rather less variable than indicated by previous descriptions. *R. guerinii* var. *costulata* Alder has been distinguished mainly on its smaller size, colour and by having sharper ribs. There is no difference in the shape of the mouth or suture, in the number of ribs per whorl or in the apical angle.

Mediterranean—British (South and west coasts).

R. splendida Eichwald. (Pl. IIo) Height 5–6 mm. *Shell rotund with a sharply-pointed apex.* Apical angle 45°–55°, usually 50°. 6–7 rounded whorls, deep suture. *10–14 longitudinal ribs per whorl, fairly heavy and rounded rather than sharp-edged, on all whorls except at the apex* and the last part of the body whorl. Punctations as such not usually present but fine spiral lines are cut by growth lines. Labial rib heavy, the thickening may be internal as well as external. Mouth round or angled at the top. Colour olive green with a purplish-red peristome and whitish labial rib. *Spiral rows of red dots are present* especially on the body whorl. This species is rather like *R. lilacina* and

R. rufilabrum but may be distinguished from these at once by the presence of ribs on most of the whorls.

Mediterranean.

R. violacea Desmarest. (Pl. IIi,j) Height 6 mm. *Shell very smooth in outline* Apex sharply pointed but commonly broken. *Apical angle* ranges in extreme forms from 34°–47°, but commonly the variation is only *between 37° and 43°*. 5–6 flattened whorls, *suture very slight indeed. 9–14 low longitudinal ribs per whorl, usually 12*. These generally do not reach the top of the whorl. They are found on 2–3 whorls with the upper 2–4 whorls smooth, and are also lacking on the last half of the body whorl. The number of ribs on the body whorl is very variable and not significant. The total number of ribs is of the order of 25–30. A fine regular reticulate pattern of rectangular pits forms the characteristic punctation found on all the ribbed whorls and the last half of the body whorl. This ornament is usually worn off over the ribs. The punctations are in 2–4 longitudinal rows between the ribs but arranged obliquely to the ribs, and there are 2–3 spiral rows of pits at the tops of the whorls above the ribs. *Mouth drop-shaped, pointed at the top.* Labial rib thick, sometimes thickened internally as well as externally, and the whole *peristome area is thickened and much reflected* over the body whorl and columella. Colour white to pale mauve or cream, shell shiny but not transparent. *The body whorl has a wide violet spiral band at about the midline and the upper whorls each have a purple to maroon or brown thin spiral band* a little above the suture, Labial rib white.

Mediterranean and western France to Brittany. One specimen (Salisbury collection, Royal Scottish Museum, Edinburgh) is labelled as from Skye, and several others, in a mixed sample of species with several localities shown from south-west Scotland belong to the Knight collection, Hunterian Museum, Glasgow. It is open to debate as to whether these represent rarities or whether the localization is inaccurate. Because of her acquaintance with the former collection the author inclines to the latter view.

R. lilacina Rècluz (Pl. IIk,l) Height 5 mm. *Apex blunt, shell heavy. Apical angle usually within the range 42°–48°*; this is a very variable character even in otherwise unvarying samples. 5–6 *whorls, somewhat shouldered, suture not deep but incised*. The whorls may be a little rounded but the shell is not rotund. *14 rounded longitudinal ribs per whorl.* Fewer ribs may be found, but if there are more than 14 the specimen may be a variety (see below). *The ribs have rather knobbed tops*, but are not varicose or tuberculate. This increases the shouldered look. The ribs reach the suture and extend to a little below the mid-line of the whorl. Ribs are found on 2–3 whorls, the upper 2–4 whorls are smooth, and the last part of the body whorl is without ribs. There are 5–9, usually 7 ribs on the ventral part of the body whorl, and there is a total of 22–30 ribs. A fine regular reticulate punctate pattern of pits is present on all the ribbed whorls and the whole of the body whorl.

As in *R. violacea*, the longitudinal rows of pits are oblique to the longitudinal ribs, and there are 3–4 such rows between the ribs. Alternatively the punctate pattern may be reduced to deeply incised spiral lines between the ribs but worn off over the ribs. *Mouth squarish, angled above.* Labial rib very thick and may be reinforced inside the mouth. *Peristome much reflected* over the body whorl and the columella, *rather callused.* Colour in fresh and live specimens rather greyish green, dull. Peristome area paler and labial rib yellowish. *In worn specimens the shell is shiny and pale to brilliant lilac in colour*, sometimes uniform and sometimes a little paler at the suture. The labial rib is white to yellow or orange. Very occasionally there may be brownish-red streaks between the ribs. Widely distributed in the Mediterranean and on western coasts of the continent of Europe. Around England it has been found in the English Channel as far east as the Isle of Wight and it extends up the Irish Sea, on the east side only, as far as north Wales. One specimen has been seen from the Isle of Man. None have been found from the east coast of Ireland, but it has been found all round the south-west and west coasts. Rarely found in Scottish waters, with one sample obtained from Skye and another labelled both Shetland and Torquay (National Museum of Wales, Cardiff).

A form differing from the typical in that the whorls are less shouldered, the longitudinal ribs are 15 per whorl, the apical angle is fairly constant at about 50°, and the mouth is not so strongly angled at the top is also found. The mouth is not as round as in the typical form of *R. rufilabrum.* Peristome are thick but not as thick as usual. Colour less brilliant, greyish. Not apparently common but widely distributed, especially in western Scotland.

R. rufilabrum Alder. (Pl. IIm,n) Height 5 mm. *Shell rotund with a sharp apex,* not as heavy as *R. lilacina*, varies from thick to thin and transparent. Thicker shells are dull. *Apical angle of 50° and may be as high as 57°.* The fattest species in the group. 5–7 rounded whorls, *suture fairly deep. 16 or more longitudinal ribs per whorl, seldom found on more than 1½ whorls* and generally covering just one whorl. The ribs reach the suture but may not reach the periphery. The upper whorls are smooth, and the last part of the body whorl is without ribs, the ventral part having about 8 ribs. Total number of ribs 16–22, occasionally as many as 25. Despite the fact that ribs are found on fewer whorls than in *R. lilacina*, the ribless whorls are not consistently more in number than in this species, as indicated by Nordsieck (1968, p. 54), because the apex may be broken off during life. A regular reticulate fine punctate pattern of pits is present on the ribbed whorls and the whole of the last whorl. The pits may be obscured by the periostracum but are visible through the outer lip, looking from the inside. *Mouth round, labial rib generally rather weak on the outside but commonly reinforced by an inner rib. Peristome only slightly reflected over the columella and not reflected over the body whorl.* A tiny umbilicus may be present, especially in thinner-shelled and juvenile specimens. Periostracum rather woolly. Colour olive green in the fresh or live specimen, periostracum similar. Peristome area flushed with red or mauve, especially on the columella. This is the first colouring to fade in dead shells. Brownish streaks, irregular or longitudinal, may be present on the lower whorls. This colour also fades. Inside of the mouth iridescent. Old shells white, dull.

Widely distributed in British and Irish waters, from the Channel Islands, where it appears to be much scarcer than *R. lilacina*, and the western part of the English Channel coast, not recorded from Wales but found around Ireland, from Bantry Bay to Galway and Donegal, where again it seems less common than *R. lilacina*. In the Clyde and Minch areas of western Scotland it is much more abundant than *R. lilacina*. It is not known from Shetland but found in Norway.

R. rufilabrum var. *paucicostata*. (Pl. IIq) Very similar to the above. The difference is in the fact that the longitudinal ribs, usually totalling 7–13 in number, are only found on the ventral part of the body whorl above the mouth. The ribs are just as close together as in *R. rufilabrum*.

Distribution is the same as for *R. rufilabrum*. It is as common in Scotland but commoner in Norway.

R. porifera Lovén (Pl. IIp) Height 6 mm. *Shell swollen with a pointed apex.* Whorls rounded to flattened, suture correspondingly moderate to slight. Apical angles 48°–50°, occasionally as low as 40°, but the width of the angle is independent of the rotundity of the whorls. *Shells thin, ornament consists of punctations and growth lines only.* Peristome only slightly reflected over the body whorl and columella. Labial rib thin. Mouth round or squarish. *Periostracum woolly or bristly.* Umbilicus may be present. Colour is variable, from colourless to greenish yellow or horn colour or even iridescent maroon.

Not found around England and Wales, but it occurs around Ireland from Bantry Bay to Donegal in sheltered waters, and is also most abundant in Western Scottish waters. In all these localities it apparently occurs in association with *R. rufilabrum* var. *paucicostata* in about equal proportions. *R. rufilabrum* is often not found in such samples, whether because it favours slightly different environments or whether collectors have separated the forms in this way it is not possible to say. *R. porifera* is also present around Shetland where it is the dominant species of *Rissoa* s.s.

British specimens are generally more rounded in shape like *R. rufilabrum* var. *paucicostata*, but all varieties of shape are found in Norway, where it is the commonest species. Because of the variation in the Norwegian specimens, in which it is not possible to separate a distinct rounded form and a distinct flattened form, it is considered proper that all the ribless forms should be designated *R. porifera*. Jeffreys (1867, p. 33) considered that his *R. violacea* var. *porifera* had a much shorter spire than *R. violacea* var. *ecostata*, but this distinction is not valid.

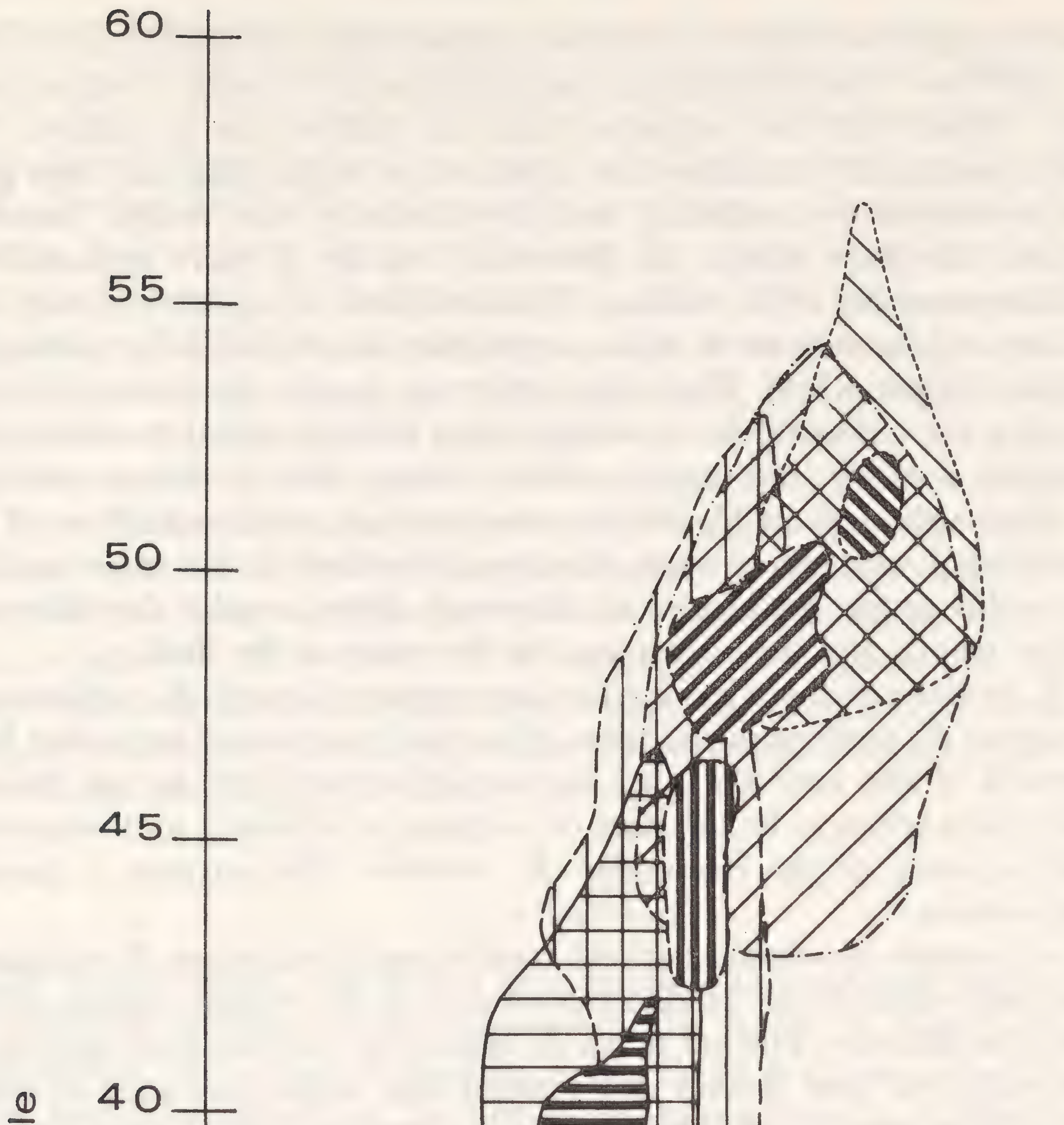

Fig. 2.

V. DISCUSSION

The descriptions show that *R. violacea* is considerably different from *R. lilacina* and *R. rufilabrum.* This difference is also borne out in Text-fig. 2 where the bulk of the *R. violacea* plot out separate from the bulk of the *R. lilacina.* Other differences, particularly the shape and construction of the shell, are even greater, and it is considered extraordinary that any confusion ever existed between *R. violacea* and the other species. As shown in Text-fig. 2, there appears to be a sequential arrangement of *R. violacea, R. lilacina* and *R. rufilabrum*, each following the other with an increase in apical angle allied to an increase in the number of longitudinal ribs per whorl. Where the latter two species are concerned the case for separating them is not quite so strong as that for separating *R. violacea.* However, Text-fig. 2 shows that despite a little overlap there is not an even spread from *R. lilacina* through its 15-ribs per whorl variant, to *R. rufilabrum.* There is even less overlap when more than one form is present in the same sample. In addition to this simple mathematical difference, there are also the difference in shape of the whorls and the mouth and the heaviness of the shell.

From *R. rufilabrum* there is a further development through *R. rufilabrum* var. *paucicostata* to *R. porifera* in the form of a trend towards an increasing lateness in the growth of ribs until the stage be reached where there are no ribs at all. Eventually there seems to be the start of a return to a heavier and more streamlined shell in some of the Norwegian *R. porifera.* This suggests a process of increasing neoteny.

There is a simple correlation between species and distribution. *R. violacea* and *R. lilacina* both occur in the Mediterranean and on the Atlantic coasts of Europe as far north as Brittany. Further north *R. lilacina* is the dominant species of the group in south and west Britain and Ireland, but within its range in sheltered places *R. rufilabrum* may also be found. It is tempting to think than *R. lilacina,* with its heavier shell, is better adapted to more exposed environments, whereas *R. rufilabrum* can only survive in the *R. lilacina* area where conditions are less rigorous.

R. rufilabrum, while by no means confined to western Scotland, is the typical Scottish form. The trend towards a less robust shell, started in sheltered places as far south as Bantry Bay, gets progressively more pronounced further north, until in Shetland *R. porifera* is the chief species.

This geographical progression follows the northerly flow of the ocean currents up the western side of Ireland and Scotland to Shetland whence the current crosses to Norway rather than flowing south along eastern Scotland. No *Rissoa* of this group has been found on the eastern side of Britain, possibly because of the more severe climate, but the suggestion is made that there is no favourable current to spread the molluscs in this direction. Their absence from eastern Ireland may perhaps also be due to this sort of cause.

As a digression from the main theme, the situation in sheltered environments is worthy of further discussion. In such places the Rissoas themselves digress from the general trends outlined above. In the Firth of Clyde, for example, the variety of form was found to be much greater than usual and also greater than expected from the amount of material available for investigation, even though this was proportionately large. Apart from the typical *R. rufilabrum* and the variety already described, a form with a heavier shell and square mouth looking very like *R. lilacina* but with 16 longitudinal ribs per whorl, and a form with a narrow shell looking like *R. rufilabrum* but with an apical angle of only 45° were also found. *R. rufilabrum* var. *paucicostata*, very common, with an apical angle of 49° had all numbers of ribs from four to 14, most having either 7–8 or 11–12. In a narrower shell there was a more evenly spread variation from 8–13. Despite this variation, shells with 12–15 ribs were much less common than those with 11 or the full *R. rufilabrum* complement of 16 or more. This variation has been present for some considerable time. A sample from the raised beach of Cumbrae (post-glacial but the age is not known with any accuracy) which was difficult to examine as the specimens were stuck on a card, contained 14 *R. porifera*, 16 *R. rufilabrum* type which may include var. *paucicostata*, and 6 heavier shells approaching *R. lilacina* type. Most were on average 5° narrower than their modern counterparts. Whether this is due to wear or was a natural characteristic is not known.

VI. SUMMARY

In the present paper a study has been made of the punctate species of Rissoa with particular reference to the supposed British forms. *R. violacea* is clearly a distinct species, and cannot be regarded as British. *R. porifera*, probably a separate species, should be placed on the British list, in addition to *R. lilacina* and *R. rufilabrum*. A new variety, *R. rufilabrum* var. *paucicostata*, has been considered worthy of a name. The variation in form can in part be linked with geographical distribution and may also be due to details of environment, but since the soft parts have not been studied it is not possible to go further and say what genetic basis for the variation is present.

VII. ACKNOWLEDGMENTS

The author wishes to express appreciation of all the people and museums who have lent specimens. These include M. Ph. Bouchet, Mrs. A. M. Brockbank, Mr. T. E. Crowley, and Mrs. S. M. Turk, who first suggested this problem and has shown continued interest in it; British Museum (N.H.), National Museum of Wales, National Museum of Ireland, Liverpool Museum, Hunterian Museum, Robertson Collection Millport, and last but not least Mr. D. Heppell, who not only placed the specimens of the Royal Scottish Museum at the author's disposal but also has given much greatly valued advice and encouragement.

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J. Conch. *27*: 249–251 (1971)

A NOTE ON THE ACCEPTABILITY OF VARIOUS WEEDS AS FOOD FOR *AGRIOLIMAX RETICULATUS* (MÜLLER)

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(*Read before the Society*, 18 *October* 1969)

Slugs are well known to feed on cereals, leguminous plants and potatoes amongst agricultural crops, and garden plants. A little information on the acceptability of common weeds is available (Gain, 1891 : Getz, 1959) but a wider knowledge of this would be useful. It was thought likely that a large number of weeds belonging to many families would provide food for slugs. Accordingly, common weeds from 19 plant families were used to examine their palatability and acceptability as food to the common grey field slug *Agriolimax reticulatus.*

The slugs were housed separately in cartons, and kept moist by means of a piece of dampened filter paper placed in the base of the carton. The lid was of thin transparent polythene through which fine holes were pierced. To test each species of plant, ten cartons were supplied with fresh leaves, and a daily record kept for a week of the amount of the leaves eaten, so that seventy observations were made for each species of plant. Daily examination ventilated the cartons, and each day the contents and lids were lightly sprayed with water. Kept under these conditions, and when a food plant was very acceptable, a large proportion of the slugs ate almost daily. For example, *Polygonum aviculare* was eaten every twenty-four hours in 62 out of 70 instances and *Chenopodium album* in 56 out of 70 instances. When the plant involved was fairly large young leaves were presented to the slugs. The two species of grass used were selected for having coarse leaves, it being concluded that species having less coarse leaves would also be accepted. The temperature at which the observations were made lay between 60° and 65° F.

The results are listed below in approximate order of their acceptability.

Eaten Readily	(Accepted on $\frac{30\text{–}65}{70}$ instances)
Ranunculaceae	Ranunculus sp.
Chenopodiaceae	*Chenopodium album* L.
Umbelliferae	*Anthriscus sylvestris* (L.) Hoffm.
Polygonaceae	*Polygonum aviculare* L.

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*Present address: 49 Humberstone Road, Cambridge.

Labiatae	*Lamium purpureum* L.
Compositae	*Taraxacum officinale* Weber
„	*Achillea millefolium* L.
Plantaginaceae	*Plantago* sp.
Gramineae	*Dactylis glomerata* L.
„	*Agropyron repens* (L.) Beauv.
Eaten less Readily	(Accepted on $\frac{20\text{–}30}{70}$ instances)
Cruciferae	*Capsella bursa-pastoris* (L.) Medic.
Umbellifereae	*Aegopodium podagraria* L.
Papaveraceae	*Papaver rhoeas* L.
Scrophulariaceae	*Veronica persica* Poir.
Compositae	*Senecio vulgaris* L.
Eaten Occasionally	(Accepted on $\frac{10\text{–}20}{70}$ instances)
Caryophyllaceae	*Stellaria media* (L.) Vill.
Urticaceae	*Urtica dioica* L.
Compositae	*Bellis perennis* L.
Rubiaceae	*Galium aparine* L.
Virtually Rejected	(Accepted on $\frac{0\text{–}10}{70}$ instances)
Rosaceae	*Fragaria vesca* L.
Onagraceae	*Epilobium hirsutum* L.
Euphorbiaceae	*Euphorbia peplus* L.
Compositae	*Convolvulus arvensis* L.
Convolvulaceae	*Matricaria inodora* L..
Polygonaceae	*Rumex* sp.
Araliaceae	*Hedera helix* L.

It is significant from the point of view of agricultural practice that heading the list, *Agropyron repens, Dactylis glomerata, Polygonum aviculare, Chenopodium album*, *Senecio vulgaris* and *Taraxacum officinale* are all extremely common field weeds, and that *Lamium purpureum* and *Anthriscus sylvestris* are common hedgerow plants.

Representatives from seven families were eaten very readily, while members of nine families were only eaten intermittently. Members of the same family were not necessarily eaten equally readily e.g. *Aegopodium podagraria* was considerably less acceptable than *Anthriscus sylvestris*, although the *Aegopodium* appears to have an equally succulent leaf. Representatives from seven families were virtually rejected.

It can be concluded that many common weeds are acceptable to slugs and that most habitats will contain an adequate supply of food.

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J. CONCH. *27*: 252 (1971)

REVIEW

Your Book of the Seashore by L. W. Stratton. 1 col. plate, 8 monochrome plates and numerous text-figs. pp. 7–72. Price 15s. Faber & Faber, 1970.

This "beginners' book" is designed to help juniors interested in seashore life and should fulfil this aim. The book starts with a short chapter on tidal levels and zoning, with an explanatory diagram. This is followed by a brief account of classification (unfortunately omitting the Lamellibranchiata), and then "Life on the Shore", occupying the major part of the book. This section deals with the different tidal habitats, and a selection of the common species occurring in each. Making a collection and caring for it, and suggested equipment for collecting, occupy the two final chapters, but we are sorry to see the old "jamjar-on-a-string" suggested. Carrying a jamjar thus is highly dangerous—either plastic containers should be used or jamjars carried in a basket. Finally a few helpful books are listed.

A few points should be mentioned; *Janthina* is not confined to Cornwall (as might appear from the text) but comes ashore on the Atlantic coasts of Ireland and Scotland also. Attention might have been drawn to the glass-like transparency of *Pleurobrachia*. English names, of course, are not important, but surely the name Painted Top is more appropriately given to *Calliostoma zizyphinum*, and not to *Gibbula magus* which might be suitably termed Great Top?

Unfortunately Mr. Stratton has consistently omitted author's names throughout, presumably because they are too "difficult" for beginners.

Your Book of the Seashore is well illustrated with clear text-figures, a beautiful col. plate of a hermit-crab as frontispiece, and 16 fine monochrome photographs on the 8 plates. In 54 pp. of text (plus index) Mr. Stratton has managed to cover a great deal of ground in a simple yet interesting way.

NORA F. MCMILLAN

J. Conch. 27: 253-255 (1971)

WILLIAM PENNINGTON COCKS (1791-1878), A WEST COUNTRY NATURALIST

Stella M. Turk
Shangri-La, Reskadinnick, Camborne, Cornwall.

(*Read before the Society, 16 May 1970*)

If like Proust we think of our personal pasts as stilts on which we must balance, then we must also believe that science itself rests on its past—often precariously. The ability to manoeuvre such stilts is related to an understanding of their origins. Our present highly specialised, statistically-based professional attitudes in biology could not have come about had it not been for the few highly articulate, industrious and many-sided amateurs who helped to lay the foundations of modern natural history studies in the last century. Dr. W. P. Cocks, still alive less than a century ago, and in his working life a valued correspondent of such outstanding authorities as Milne Edwards, Yarrell, Gosse, Couch, Johnston and Ralfs, as well as those great linked conchologists, Forbes and Hanley and Alder and Hancock, was just such a naturalist.

Described as "this Gilbert White of Falmouth" by Davey (1909), Cocks was a very acute observer and collector, coupling these attributes with a diligence in recording all that he saw. He was born in Devon in 1791 and became a surgeon like his father. However, owing to ill-health, when he was still only 51 he retired to Falmouth in Cornwall. From 1843 onwards he carried on his natural history observations although he published nothing about Falmouth's fauna and flora until 1849 when two or three papers appeared, including a "List of Echinodermata procured in Falmouth and neighbourhood from 1843-1849" (*Trans. Penz. Nat. Hist. Ant. Soc.* I:292). Like other men of his time, Cocks was compressed into no narrow mould, but wrote on *all* types of animals and plants, as well as being well known as a political publicist, achieving some fame for his cartoons. Whilst still a medical man his coloured drawings were used for Professor Cooper's *Dictionary of Surgery* as well as in works by other leading medical men. His artistic skill, coupled with a fine sense of humour, found an outlet in political cartoons, championing the Liberal Party. But perhaps one of his more unusual achievements was the production of numerous articles written. lithographed and reproduced by himself. Thirty of these papers, many undated, are listed in Boase and Courtenay (1874) and others are known only from private collections (Davey 1909). The titles include the following:—

"Common objects of the sea-shore" Falmouth.
Nudibranchiate Mollusca" Quarto pp. 8. Falmouth.
"Chitons" Quarto pp. 12. Falmouth.
"Salt Water Mollusca" Quarto pp. 16. Falmouth.

"Hints for facilitating the Records of Natural History". Quarto. Falmouth.
"Guide to the Fish Market etc." An oblong folio sheet. Wm. Tregaskis, Falmouth 1869.

Outside the field of natural history the following titles are to be found:—

"The Life of Jesus Christ—compiled from the New Testament". Written for the Bazaar. Octavo pp. 16 and mss. quarto pp. 122. Falmouth.
"Rules to be observed in practical life etc.". Quarto pp. 24. Falmouth.
"Forms for the record of Post Mortem Examinations". Octavo pp. 8.

It is said that he sold these lithographed sheets, including those on biology, for a penny each at the local Church Bazaars; certainly one (see above) was written especially for such a Bazaar.

A few of his other numerous papers were published in the *Journal* of the Royal Institution of Cornwall and elsewhere, but most appeared in the *Report* of the Royal Cornwall Polytechnic Society. Those specifically on molluscs are as follows:—

1839. *Kellia rubra. Mag. Zool. Bot.* **4**: 54.
1850. Land slugs found in Falmouth and neighbourhood. *J. roy. Instn. Cornwall* **18**: 28–30.
1856. Slugs. *Rep. R. Cornwall polyt. Soc.* **24**: 20.

Other references to molluscs are scattered amongst his several papers on the fauna of Falmouth which appeared from 1849–1854 (inclusive): 1856–1864 (inclusive): 1869, 1870 and 1877 in *Rep. R. Cornwall polyt. Soc.*

Cocks died in 1878, aged 87. It is not known what became of his collections. None are in the County Museum with the Royal Institution of Cornwall material. It may be that they were in the Museum of the Royal Cornwall Polytechnic Society, the complete contents of which were sold a few years after the last war when interest had dwindled to a very low ebb.

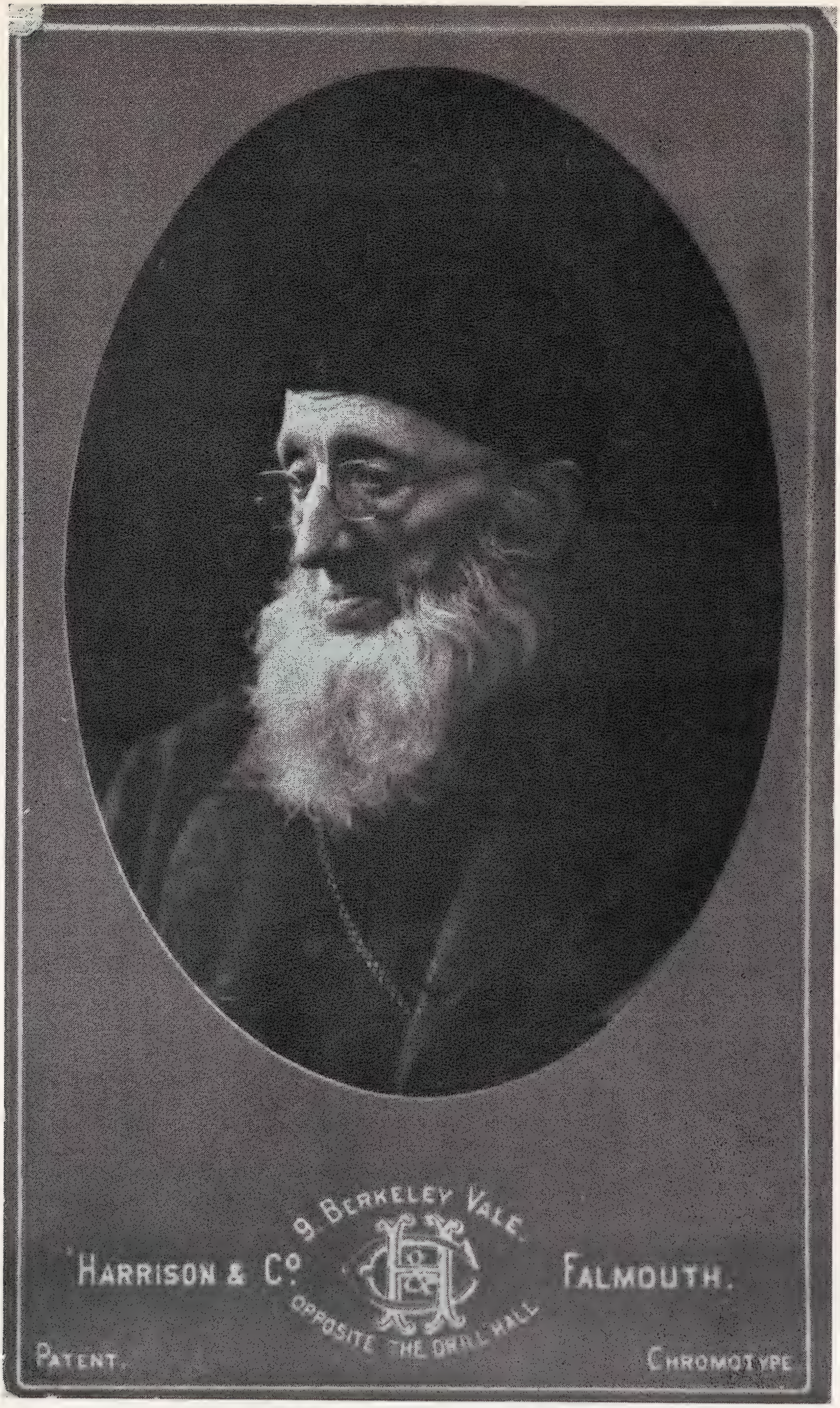
A minor but still significant figure in the history of conchology, Cocks exemplifies a type of liberal, semi-professional scholar-naturalist which dates back to the 17th century and which was to continue into the 20th century. Many of these men were clergymen or doctors and their role in the development of the natural sciences in Cornwall, typical in this one way at least of other remote counties, is discussed by Turk (1959). All but extinct today, they are representative of a time when the humanising influence of science could still be seen as a cultural phenomenon of the utmost reality.

A full account of Cocks' life and a list of most of his published work is to be found in the second of the following three works, whilst the first contains the titles of the majority of those lithographed by himself.

ACKNOWLEDGMENTS

Acknowledgments are made for the use of the photograph of Dr. Cocks to the Royal Institution of Cornwall.

PLATE X



William Pennington Cocks (1791-1878)

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J. Conch. *27*: 256 (1971)

REVIEWS

Review of the Volutidae by Maxwell Smith. Lantana, Florida: Tropical Photographic Laboratory. Published by authority of the Beal-Maltbie Shell Museum, of Rollins College, Winter Park, Florida. Reprinted 1968 from the original 1942 edition. pp. 70, 26 plain pls. of 185 figs. $10\frac{3}{4}''$ × $8\frac{1}{4}''$. Price U.S. $10.00 Obtainable from Philip Clover, Apartado de Correos 22, Rota, Cadiz, Spain.

A most useful book of reference for all shell-collectors and malacologists who are interested in volutes, this work has now been reprinted by the original publishers, the 1942 edition having been out of print for some time. A five-page introduction covers such items as the bibliography of the genus, nomenclature, types of nucleus and distribution. The text proper gives for each species or variety the synonymy, habitat, a full description of the shell including size in mm., and in some cases any other points thought to be of interest. The description of one volute is in French and of another in Latin, with no attempt at translation in either case. For each genus the synonymy, genotype and range of the genus are also given Few references are made to the animal or its anatomy.

The black-and-white illustrations, mostly photographic, are somewhat lacking in detail, and the paler portions of the shells tend to merge with the background. Nevertheless, the figures are adequate for identification, especially if used in conjunction with the text. They are mostly life-size, and where this is not so the fact is clearly indicated, but where the figures are reduced it is necessary to refer to the text to find the actual size. There is good cross-referencing between figures and text, the latter being well indexed with synonyms in italics.

It is almost thirty years since the original date of publication of this monograph, and not only have there been new ideas about classification but much more is known now about the living molluscs, and inevitably new species have been described. A comparison between this book and a new work. "Living Volutes", which is already in press would, no doubt, underline these facts, but the price of the latter which is more than five times that of the volume under review, coupled with the scarcity of other good literature on the Volutidae, should ensure that this re-issue of Maxwell Smith's authoritative work receives a warm welcome from all who seek information on this popular group of shells.

R. R. Scase

J. Conch. *27*: 257–265 (1971)

ON *FAGOTIA ACICULARIS* (FÉRUSSAC) FROM THE QUATERNARY DEPOSITS IN THE VALLEYS OF HELME AND UNSTRUT

Hildegard Zeissler
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(*Read before the Society, 16 May 1970*)

The fresh-water prosobranch *Fagotia acicularis* (Férussac) is still living in the rivers that flow into the Black Sea, but the Danube forms the western limit of its range. It is found in Hungary and in several isolated places in Austria. Usually the snail is found on stones or roots, though in slowly moving water it may also occur on mud.

Within its range it has been found in quaternary deposits of different ages, but since the last century an isolated fossil occurrence has been known in Middle Europe, in deposits of rivers tributary to the Saale and Elbe. There the species has been found at five places in the valley of the lower Unstrut and its left tributary the Helme. Three of these localities are quoted by Wüst in his important paper of 1900: "Muschelton" of Edersleben (Helme), "Melanopsenkiese" of the Hoppberg near Rossleben and from Zeuchfeld (both in the Unstrut valley).

In 1902 he made known another locality for fossil *"Melanopsis"* (=*Fagotia*), the Unstrut Gravel of Bottendorf, only a short distance up the Unstrut from Rossleben. Since then one further locality has been found, the Unstrut Gravel of Kalbsrieth, already searched by Wüst (1900) who found no fossils. However in 1963 we obtained many fossil shells from this locality (Zeissler 1968); we took several samples and worked them quantitatively. (Wüst gave only a list of the species identified from each locality). A short description of each of the five localities follows:

Edersleben

The "Muschelton" of Edersleben is the oldest horizon of a considerable Pleistocene deposit, resting on tertiary strata. In this century it has not been opened again.

Wüst (1900: 158) says that it was deposited by a muddy, slowly running part of the river. In 1904 he terms it a buried river-channel ("Altwasserabsatz"). The horizon is up to 2 m. thick, greyish green to nearly black in colour, plastic and foliated at the same time, and when put into water there is a residue of small schisty flakes. The clay contains many organic remains; Wüst quotes as well as shells of Mollusca also remains of plants, Ostracods and fish, but no northern rocks, so he dates it from the first inter-glacial.

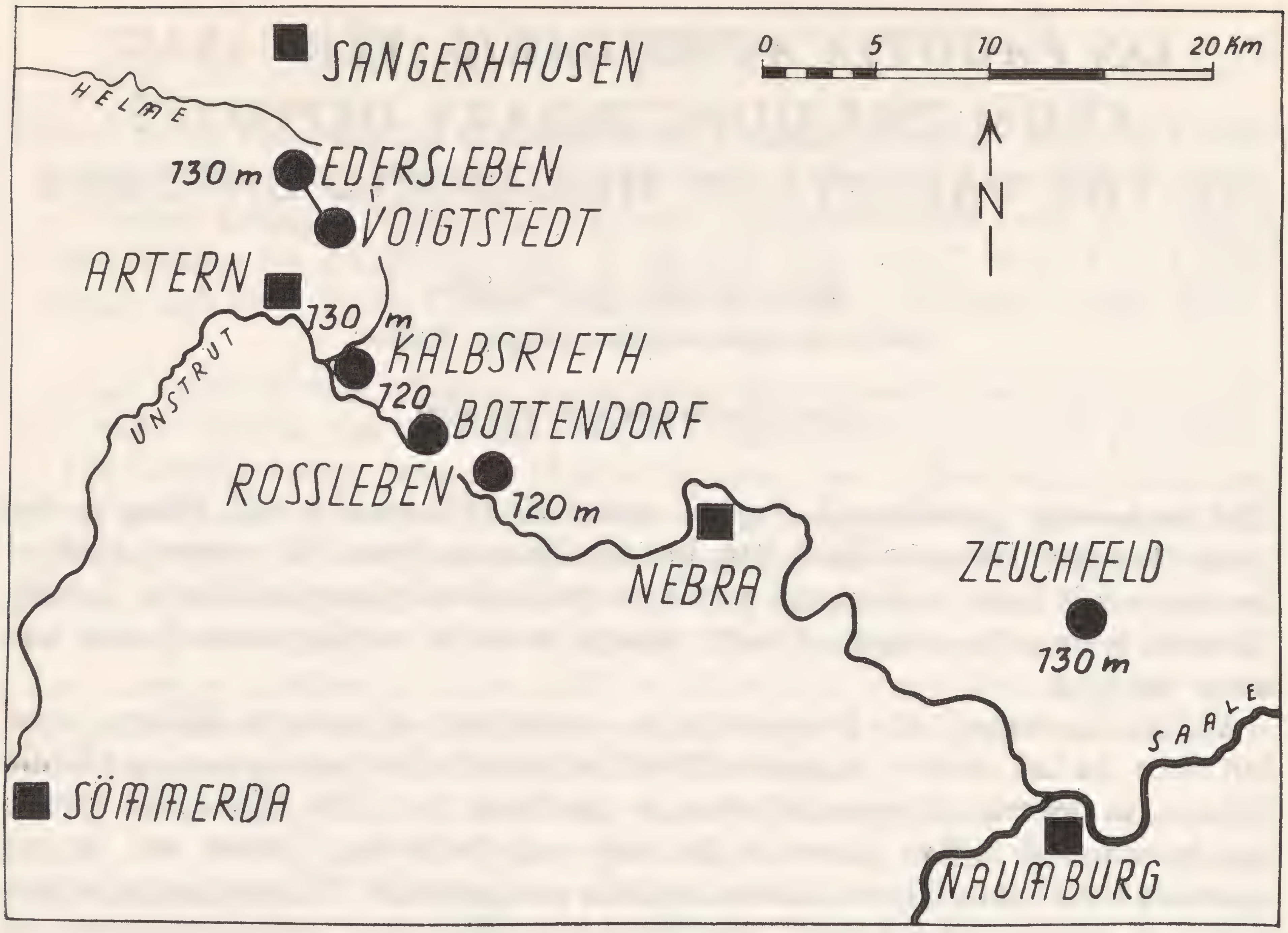

Fig. 1.

He found there eight different species of shells, all fresh-water. His specimens of *Fagotia* were mostly broken, but he found more than a hundred of them. Later on Kayser (1924) found thirteen species, among them *Lithoglyphus pyramidatus* (Möllendorff) and *Corbicula fluminalis* (Müller), species also extinct in Thuringia. All these have extremely strong shells, like *Fagotia*.

Kalbsrieth

The gravel of Kalbsrieth is still accessible in the gravel-pit S.E. of the village, a few hundred m. down the Unstrut. Wüst did not obtain any fossils there but he found that the gravel contained no northern rocks. He says that it was deposited by an Unstrut that had already been united with the Helme (Wüst 1900 : 148).

There we found 46 species of Mollusca, half of them land snails. We also obtained more than 100 *Fagotia* shells, mostly damaged, and the few intact specimens were worn and eroded. Other species of special interest obtained were;

Belgrandia germanica (Clessin)
Discus ruderatus (Studer)
Ruthenica filograna (Rossmässler)
Candidula sp

These species all suggest a deposit during an interglacial or a warm period, as does *Fagotia*, but they are all much more fragile.

Bottendorf

At Unstrut gravel of 3-4 m. thickness was accessible at the time of Wüst in the so-called Meyer's gravel-pit. It was covered by a greyish-yellow loess nearly 1 m. thick and here Wüst found a few northern rocks among the material.

From this gravel Wüst quotes 42 species of shells, 13 land snails among them. He states positively that he found here the bivalves *Unio* and *Corbicula* in great numbers and often with both valves still connected, showing that the shells were lying where the animals had lived and died. Though he does not state what quantity he had taken for a sample, by the numbers of species collected we may judge that he investigated a considerable amount of gravel yet he only records a single *Fagotia* shell.

As *Corbicula* and *Fagotia* suggest a warm climate for Thuringia, Wüst dates the deposit from the 2nd or 3rd interglacial period. But as Steusloff (1953) pointed out, *Corbicula* has been extinct in Middle Europe since the 2nd interglacial period and therefore this gravel cannot be younger. Wüst thinks that his single *Fagotia* may be redeposited in a secondary position.

The Hoppberg Gravel near Rossleben

The gravel layer at the Hoppberg was opened when the railway was constructed, and the pit was worked from 1888 to 1889. When Wüst visited it the sides were already covered with vegetation. He says (1900 : 167) that he dug in the floor of the pit, but not very deeply as the water-table had been reached. He found in the gravel a high percentage of northern rocks, so the Hoppberg Gravel cannot be of the same age as the "Muschelton" of Edersleben and the gravel of Zeuchfeld.

Here he found numerous *Fagotia* shells and he emphasizes that they could not be in a secondary position, redeposited from Edersleben, for the specimens from the Hoppberg are less worn that those from the Edersleben clay. Furthermore he found 20 species of Mollusca, eight land snails among them. He noted only one valve of the strong warm-water bivalve *Corbicula fluminalis*, lying loose on the ground; this also could have come from elsewhere. He also found *Vallonia tenuilabris* (Al Braun), a land snail that suggests a rather cold climate in contradiction to *Fagotia*.

Zeuchfeld

The "*Melanopsis*"-gravel of Zeuchfeld lies on Pliocene strata. It was deposited by the Unstrut at a time when the Unstrut was united with the Saale near Weissenfels instead of just below Naumburg as it is now. Wüst describes a basal gravel about 2 m. thick and over it a sand of 0·4–0·5 m. The gravel contains essentially shells of fresh-water Mollusca, but not in good condition. He collected hundreds of *Fagotia* but all were broken, worn and eroded. He also found a

Lithoglyphus, which he recorded as *L. naticoides* in 1900 but later (Wüst 1912) named it *L. pyramidatus.* Altogether he found 19 species, but only six of these were land snails He mentions having obtained also one incisor of an *Arvicola* and a bovid molar.

He is of the opinion that the Zeuchfeld gravel might be of the same age as the clay of Edersleben, if the gradient of the Unstrut river at the time of the deposit was no greater than today. The Unstrut must have been fast-flowing near Zeuchfeld. The differences between the faunas might be caused by the different physical conditions, at Edersleben the deposit of a muddy branch, at Zeuchfeld of a fast-flowing river.

Wüst's thoughts on the age of the deposits

In 1900, when only three places were known Wüst wrote 1900: 194) "It is not at present possible to point out sure equivalents of the Thuringian *Melanopsis*-strata from anywhere". And it is still impossible.

By comparing these deposits with the gravel of Wendelstein, which does not contain *Fagotia,* he considered that the *Fagotia*-strata of Edersleben and Zeuchfeld must be younger than the deposits of the Mosbach Complex. He admits, however, that the criteria for a relative dating are most inadequate.

Owing to the fact that he found *Fagotia* in deposits with northern rocks as well as in those without them, and that the specimens from the younger gravel at the Hoppberg are in a better state than those of the older deposits, he suggests that *Fagotia* might have immigrated twice into the Unstrut valley. He thinks it probable that *Fagotia* may be found in other deposits of Middle Europe. Every occurrence of fossil *Fagotia* outside its recent range and out of the Unstrut valley would be important for judging whether it has immigrated once or twice, the route of immigration, and the dating. But unfortunately although more than fifty years have elapsed since his last word on the matter, the species has only been found at Kalbsrieth, lying between the old localities, and this new locality does not even increase the range of *Fagotia* within the Unstrut valley.

Comparing the Mollusc Faunas

It must again be emphasized that the faunas of the five deposits are not all known thoroughly. Wüst gave simple lists of species in his early papers. The Kalbsrieth gravel is partly worked stratigraphically but that concerns only a small part of that great complex. So in Table 1 all five faunas are given as lists.

All those faunas, except perhaps that of the Edersleben clay, do not consist only of the Mollusca of the river but are mixed. In the gravel of Kalbsrieth we find especially many land snails, not only from the river banks but also from the forest in the neighbourhood and the sides of the valley. In the Bottendorf gravel there are mostly snails and bivalves of shallow water such as ponds and ox-bows but also species characteristic of the river. But as the different faunas have been worked with varying thoroughness we cannot discuss their composition here. The fauna of that part of the Kalbsrieth gravel already worked stratigraphically

TABLE 1

	Edersleben	Kalbsrieth	Bottendorf	Rossleben	Zeuchfeld
Prosobranchia:					
Viviparus sp. fr. (thin shell)	—	—	—	—	1
Valvata cristata (Müller)	—	2	2	—	—
* *Valvata pulchella* (Studer)	—	—	3	—	3
Valvata pulchella macrostoma (Steenbuch)	—	—	—	—	4
Valvata piscinalis (Müller)	5	5	5	5	5
Valvata piscinalis antiqua (Sowerby)	6	—	6	—	—
* *Belgrandia germanica* (Clessin)	—	7	—	—	—
* *Lithoglyphus pyramidatus* Von Mollendorf	8	—	—	—	8
Bithynia tentaculata (L.)	9	9	9	—	9
* *Fagotia acicularis* (Férussac)	10	10	10	10	10
Basommatophora:					
Physa fontinalis (L.)	11	—	—	—	—
Galba truncatula (Müller)	—	12	12	—	—
Stagnicola "palustris" (Müll.)	—	13	—	13	—
Radix peregra peregra (Mull.)	—	—	14	—	—
Radix peregra ovata (Drap.)	—	—	15	15	—
Radix peregra ovata aff. obtusa Kobelt	—	16	—	—	—
Lymnaea stagnalis (L.)	—	17	17	—	—
Lymnaea sp. frgm.	18	—	—	—	18
Planorbis planorbis (L.)	—	19	19	19	—
Anisus leucostomus (Millet)	—	20	20	20	—
Spiralina vortex (L.)	—	—	21	—	—
Bathyomphalus contortus (L.)	—	—	22	—	—
Gyraulus albus (Müller)	—	23	23	—	—
Gyraulus laevis (Alder)	—	—	24	24	—
Armiger crista nautileus (L.)	—	—	25	—	—
Armiger crista cristatus (Drap.)	—	—	26	—	—
Hippeutis complanatus (L.)	—	—	27	—	—
Segmentina nitida (Müller)	—	28	28	—	—
Segmentina nitida micromphala Sandberger.	—	—	29	—	—
Planorbis sp. fragm.	30	—	—	—	—
Ancylus fluviatilis (Müller)	—	31	31	31	31
Acroloxus lacustris (L.)	—	—	32	—	—
Stylommatophora:					
Cochlicopa lubrica (Müller)	—	33	33	33	—
Cochlicopa nitens v. Gallenstein	—	34	—	—	—
Vertigo antivertigo (Drap.)	—	—	35	—	—
Pupilla muscorum (L.)	—	36	—	—	—
Vallonia enniensis (Gredler)	—	—	37	—	—
Vallonia pulchella (Müller)	—	38	38	—	38
Vallonia costata (Müller)	—	39	39	39	—
* *Vallonia tenuilabris* (Al. Braun)	—	—	—	40	—
Chondrula tridens (Müller)	—	41	—	—	41

	Edersleben	Kalbsrieth	Bottendorf	Rossleben	Zeuchfeld
Succinea putris (L.)	—	—	—	42	—
Succinea elegans (Risso.)	—	43	—	43	—
Succinea oblonga (Drap.)	—	44	44	44	—
Succinea sp. fragm.	—	—	45	—	45
* *Discus ruderatus* (Studer)	—	46	—	—	—
Discus sp. fragm.	—	—	—	—	47
Nesovitrea hammonis (Ström)	—	48	48	—	—
Zonitoides nitidus (Müller)	—	—	49	—	—
Clausilia pumila (C. Pfeiffer)	—	—	50	—	—
Laciniaria cf. cana (Held)	—	51	—	—	—
* *Ruthenica filograna* (Rossmässler)	—	52	—	—	—
Clausilia sp. fragm.	—	53	—	—	—
Bradybaena fruticum (Müller)	—	54	54	54	—
Helicopsis striata (Müller)	—	—	55	—	—
Candidula sp. fragm.	—	—	56	—	—
Perforatella bidentata (Gm.)	—	57	—	—	—
Perforatella incarnata (Müll)	—	58	—	—	—
Trichia cf. edentula frgm.	—	—	—	—	59
Trichia hispida (L.)	—	60	60	—	—
Euomphalia strigella (Drap.)	—	61	—	—	—
Helicodonta obvoluta (Müller)	—	62	—	—	—
Helicigona lapicida (L.)	—	63	—	—	—
Arianta arbustorum (L.)	—	64	—	64	—
Cepaea sp. fragm.	—	65	—	—	—
Helix sp. fragm.	—	—	—	—	66
Bivalvia:					
Unio pictorum (L.)	—	67	67	—	—
Unio crassus batavus (Maton & Rackett)	—	—	68	—	68
Unio sp. frgm.	69	69	—	69	—
Anodonta sp. frgm.	—	—	—	—	70
* *Corbicula fluminalis* (Müller)	71	—	71	71	—
* *Corbicula fluminalis aff. crassula*	—	—	73	—	—
Sphaerium solidum (Normand)	73	73	—	—	73
Sphaerium cornem (L.)	74	—	—	—	—
Sphaerium sp. fragm.	—	—	—	—	75
Pisidium amnicum (Müller)	—	76	76	—	—
Pisidium henslowanum (Sheppard)	—	77	—	—	—
Pisidium supinum (A. Schmidt)	—	78	78	—	—
Pisidium nitidum (Jenyns)	—	79	—	—	—
Pisidium personatum (Malm)	80	—	—	—	—
Pisidium obtusale (C. Pfeiffer)	—	—	—	81	—
Pisidium casertanum (Poli)	—	—	—	82	—
Pisidim mōitessierianum (Paladilhe)	—	—	—	—	—
Pisidim sp. frgm.	—	—	83	—	—

has been discussed previously (Zeissler 1968). We can only say that the species of special interest, marked with * in the table, suggest an interglacial, probably rather warmer than today, e.g. *Fagotia, Corbicula, Belgrandia.* The single specimen of *Vallonia tenuilabris* (Al. Braun) from Rossleben is an exception, suggesting cold conditions. But it may have been a relict or redeposited in a secondary position. In all those faunas *Fagotia* was present, but we shall point out also the other constant species (see Table 2).

TABLE 2

CONSTANT SPECIES

	Edersleben	Kalbsrieth	Bottendorf	Rossleben	Zeuchfeld
Fagotia acicularis (Fér.)	1	1	1	1	1
Valvata piscinalis (Müll.)	2	2	2	2	2
Bithynia tentaculata (L.)	3	3	3	—	3
Ancylus fluviatilis (Müll).	—	4	4	4	4
Planorbis planorbis (L.)	—	5	5	5	—
Anisus leucostomus (Millet)	—	6	6	6	—
Vallonia pulchella (Müller)	—	7	7	—	7
Vallonia costata (Müller)	—	8	8	—	8
Succinea oblonga (Drap.)	—	9	9	9	—
Bradybaena fruticum (Müller). frgm.	—	10	10	10	—
Unio sp. frgm.	11	11	—	11	—
Corbicula fluminalis (Müller)	12	—	12	12	—
Sphaerium solidum (Normand)	13	13	—	—	13
species	6	12	11	9	7

These are mostly rather euryoek mollusks of the river and its banks with fragile shells, that could have lived there at any time when the land was ice-free. On the contrary, *Fagotia acicularis* and *Corbicula fluminalis*, both indicators of a warmer climate, have extremely solid shells, that could have been removed and redeposited even several times.

Wüst (1900) thought it possible that *Fagotia* might have twice immigrated into Thuringia. But as now, seventy years after his researches, no Pleistocene deposits containing the species have been detected between its recent geographical range and the Unstrut valley, we ask whether it occurs primarily in even one of the deposits mentioned?

To make our question clear we give photographs both of the *Fagotia* from Kalbsrieth that in condition does not differ from those Wüst figured from Edersleben and Zeuchfeld, and Hungarian Fagotiae of different ages.

At first glance we see that in calcareous tufas, where the shells must have been deposited without having been transported over a long distance, *Fagotia* shells are in far better condition. The term "subfossil" for specimens from the Danube sand means that their age is unknown. In sifting we may find in the same sample of sand fresh recent, bleached quaternary, and marine tertiary shells. The tertiary marine shells hardly differed in condition from the Fagotias of the same sample, but the other fresh-water shells, though more fragile, were more nearly intact. And the most bleached, most worn specimens from the Danube sand look just like those from the Unstrut valley.

In any case *Fagotia* must once have arrived in the Unstrut valley, have prospered there and lived in fairly large numbers in a relatively small area. Probably that was earlier than Wüst thought, perhaps still in the Tertiary period, and during the Pleistocene they may have been removed and redeposited once or several times. Only in this way can we explain why even in the Edersleben Clay the shells are broken and worn, for we know that as a rule shells in marly deposits are usually intact.

If the Unstrut Fagotias are older, then we can see why no more localities for the species have been found between the Danube and the Unstrut valley. But then also *Fagotia acicularis* ceases to be an indicator fossil of the Thuringian Cromer deposits (Zeissler 1965a).

SUMMARY

Far beyond the Recent range of *Fagotia acicularis* (Férussac) round the Black Sea we find the species at five places in Thuringia on the rivers Helme and Unstrut, all in quaternary deposits. Three of these deposits contain no northern rocks, two do, so they are not of the same age. As Wüst (1900 : 170) found that one of the younger strata at the Hoppberg, near Rossleben, contained the least damaged shells, he thought that they could not have been redeposited there from older deposits and belived they must have immigrated twice.

But we must point out that even the Fagotias in the Edersleben clay, in spite of their solidity, are worn, eroded and broken "Quite intact shells have not been collected, or could not be won out of the marl" (Wüst 1900 : 157), though in marly deposits shells ought to be in good condition. This fact and a comparison with the fossil Hungarian Fagotias of different ages makes us believe that all the Unstrut Fagotias are older than the strata they were found in and that they are perhaps of Tertiary age. Then we understand better why no station on the long way from the native area of the species to the Unstrut valley has been detected.

So *Fagotia acicularis* cannot longer be regarded as an indicator species for the Thuringian Cromer Interglacial.

ACKNOWLEDGMENTS

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J. Conch. 27: 266 (1971)

THREE LAMELLIBRANCHS APPARENTLY NEW TO BRITAIN

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(*Read before the Society, 16 May 1970*)

The purpose of this note is to draw attention to records of three small marine bivalves hitherto not known as British. The species are as follows:

Ctena decussata (O. G. Costa 1830). In the A. E. Salisbury molluscan material now in Liverpool Museum there is a live-taken specimen of this species labelled "Scilly, deep water, 40 fm." and also a single valve labelled "Codakia pecten found on Towan Beach, Falmouth 1912". There seems little ground for doubt as the species lives on the Atlantic coast of France.

Isomonia alberti Dautzenberg & Fischer 1897. A minute valve of this species is in the Salisbury material, labelled "Towan Falmouth". Nordsieck (1969) gives it ex the Azores only.

Bornia sebetia (O. G. Costa 1829). Alfred Bell (1898) found a valve (recorded sub *Kellia corbuloides* Phil.) on Hayle Beach, Cornwall. He states "I lately found a valve of this shell on Hayle Beach. As it was unrolled, and in the same condition as the other beach shells, it may be new to Britain". As this record appeared only in a geological paper it seems worth calling attention to it, if only to urge further search at Hayle. However, during the past century and a half Hayle beach has yielded occasional single valves of another lusitanian species, *Mactra glauca* Born, and it seems possible that all these Hayle shells are quaternary fossils, derived from a submarine deposit.

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J. Conch. *27*: 267–268 (1971)

REVIEW

Shell Life and Shell Collecting by Sonia Bennett Murray. Sterling Publishing Co., Inc. New York; British Edition by The Oak Tree Press, London and Sydney. pp. 96 with 14 pages of colour plates and numerous text illustrations. 8½ × 6½ ins., hard covers, price 35s.

The increased interest in conchology over the last few years has produced a crop of books on the subject, many of them very good indeed, and the conchologist is probably better catered for than at any time this century. It might be thought that a new book on collecting shells could have little more to say that was not embodied in other available volumes, but this is not in fact so, at any rate in this country, and there has hitherto been practically no book that one might recommend to a novice collector of tropical marine shells.

The average American shell collector is of course, interested mainly in fantastic colours and shapes, and a shell must be exotic looking before it is of much value to him. The shells of his own woods and streams and northern coasts are often of less interest. This book is aimed to guide and please the American collector, and expresses little interest in the scientific side of the hobby; for instance, popular names are used throughout, although it is stated that "... use of the Latin name is useful when exchanging specimens". The one cold water shell illustrated is titled "BLUE RAYED LIMPET Helium pellucidium", and other slips of systematics indicate the unpopularity of this aspect.

The book is marked "British Edition", but it is also made in America and there is in fact no indication that it has been adapted in any way from the original writing. The continual slight irritation of American spelling remains; all bivalves (except oysters) seem to be clams just as all gastropods (except cowries) seem to be conchs. Cephalopods receive their due meed of attention, but please let it be broadcast that the plural of Octopus is not Octopi. The binding is very strong and the cover is washable—a good point if the book is taken on expeditions, but it does have the disadvantage that if it is laid down open it immediately jumps an inch in the air and shuts itself with a snap. At 35s., the price is a little steep for an introductory work, but no doubt this is mainly due to the very attractive series of colour plates of the more brilliant shells. There are besides a good number of line and half tone illustrations to supplement the text.

Mrs. Murray treats her subject in a workmanlike way, commencing by describing the five (near enough for the majority of us)—classes of molluscs, and touching on their evolution through geological time. After this comes a chapter on How Molluscs Live, describing the various environments occupied by the creatures, their methods of reproduction, egglaying, and the intermediate stages. A note in this connection on the subject of varices infers that the difference between winter and summer temperatures dictates the "false lips", and that it is therefore possible to calculate the age of the gastropod by counting these, just as easily as the rings on a log. This may seem a reasonable assumption, but in fact proof seems quite lacking that shells add one varix per year.

Methods of collecting and preserving are discussed, and many good hints are offered: the importance of conservation is justly stressed. The Author continues by saying that finding and displaying lovely shells is fun, which sets the tone of the chapter, but even so, the problems of cleaning and preserving the specimens, with all the hard work which that involves, are fully set forth, and the aspiring collector is warned of the undoubted difficulties to come. An interesting point is made here, that barnacles settle only on thick and heavy shells, so that one is rarely faced by the danger of scraping them off a delicate surface. but how do the barnacles know? The importance of adequate labelling is satisfactorily stressed.

Shells in archaeology and history receive a chapter of their own, well known instances being quoted from both sides of the Atlantic. The popularity of the scallop in Western heraldry and architectural design is attributed to crusaders bringing the shells back from Syria, but this seems an unlikely explanation, as the scallop form would already be quite familiar to all European maritime peoples. It is more likely that the design was popularised by those who were proud to display it as the sign that they had completed the pilgrimage to the shrine of St. James at Compostella or elsewhere.

The final chapter deals with the commercial uses of the mollusc and its contributions to the World's food, not forgetting its art-forms. The book casts its net widely and touching as it does on so many facets, does not have space to go deeply into any of them. This may be done elsewhere when the desire to specialise makes itself felt, but this book seems principally and effectively designed to foster the enthusiasm of the novice: in this it should certainly be most successful.

T. E. CROWLEY

CORRECTION

In the recent paper on marine Mollusca of Lanzarote (this *Journal* 27: 27–43. 1969) *Conus betulinus L.* is referred to. Mrs. Thora Whitehead has pointed out to me that this should read *Conus prometheus* Hwass throughout.

JOHN H. DUFFUS

J. Conch. *27*: 269–271 (1971)

DESCRIPTIONS OF TWO NEW SPECIES OF FOSSIL FRESHWATER MUSSELS (*UNIONIDAE*) FROM GREENLAND

F. R. Woodward

Shipley Art Gallery, Gateshead, Co. Durham.

(*Read before the Society, 19 March 1966*)

During studies of the British Tertiary Freshwater Mussels my investigations brought to light two new species from the Cretaceous-Tertiary deposits of North Greenland in the Palaeontological collections of the Sedgwick Museum, Cambridge. The specimens were collected by Professor A. C. Seward in the summer of 1921 from Antanikerdluk, Nugssuak Peninsula, and are presumably from the black shale bed referred to by the collector (1926, 64) as the *Liriodendron* bed of Heer (1869) which is exposed on the west side of a small ravine at a height of about 200 feet above sea level.

As far as I can discover these are the first freshwater bivalves described from the Cretaceous-Tertiary deposits of Greenland except for the brief reference to a species of *Cyclas* by Heer (1869, 485, p. 52, fig. 10).

Unio sewardi sp. nov.

Description. Shell equivalve, inequilateral, elongate, tending to be rectangular in outline, tumid, umbones situated approximately two-thirds of the way along the length of the shell. Anterior margin roundly truncated, passing directly into the weakly convex ventral margin. Ventral margin meeting the posterior margin at its point of intersection with the anterior gonial ridge at a distinct angle, posterior margin passing ventrally from the posterior gonial ridge to the anterior gonial ridge. Dorsal to this it is obliquely truncated meeting the dorsal margin at an obtuse angle. Dorsal margin straight, tending to be parallel to the ventral margin. Umbones decorticated, gonial ridge distinct, bifurcating, the anterior ridge being more rounded, both exhibit oblique radial plications at an angle to their respective gonial axes which cut across the growth lines, being reminiscent of those found in *Lamellidens marginalis* (Lamarck). The ligament is persistent and conspicuous externally, being relatively wide and slightly produced above the level of the dorsal margin. It is divided into two regions, an anterior thickened area and a thinner posterior region. Growth lines distinct, slightly raised; under a hand lens the disc surface is found to be smooth.

The internal features of this species are unfortunately unknown.

Geological horizon. Cenomanian?, Cretaceous.

Type locality. Antanikerdluk, Nugssuak Peninsula, Western Greenland.

Dimensions. The dimensions of the holotype, Sedgwick Museum No.F.15.704 are as follows:

Length (antero-posterior)	49·0 mm.
Height (dorso-ventral at umbones)	20·0 mm.
Maximum breadth (2 valves)	16·0 mm.

Remarks. In its general outline, sculpture etc., *Unio sewardi* is strongly reminiscent of the recent South American species *Diplodon parallelipipedon* (Lea), but until further material, especially exhibiting the hinge-dentition, becomes available the relationships of *Unio sewardi* must remain in doubt.

The species is named after its collector, Professor A. C. Seward, and the holotype is deposited in the Sedgwick Museum, Cambridge, registration number F.15.704.

Unio thulei sp. nov.

Description. Shell equivalve, inequilateral, tumid, rhomboid in outline, umbones situated one-fourth of way along the length of the shell. Anterior margin convex, arising from a point just anterior to the umbones, continued obliquely ventralwards to meet the slightly curved ventral margin which meets the posterior margin at its point of intersection with the anterior gonial ridge. Posterior margin abruptly truncated passing dorsally into the curved dorsal margin. Umbonal region missing in the holotype, presumably elevated, inclined anteriorly. Gonial ridge distinct, bifurcated, giving a rostrated appearance, without any trace of sculpture. Ligament absent. The disc surface is unsculptured except for the presence of weakly developed growth lines.

Geological horizon. Cenomanian?, Cretaceous.

Type locality. Antanikerdluk, Nugssuak Peninsula, Western Greenland.

Dimensions. The dimensions of the holotype are as follows:

Length (antero-posterior)	31·0 mm.
Height (dorso-ventral at umbones)	16·0 mm.
Maximum breadth (2 valves)	12·5 mm.

Remarks. In its general outline *Unio thulei* resembles the recent South American species *Paxyodon ponderosus* Schumacher 1817 (= *Hyria syrmatophora* (Gronovius)), but until further material, in particular exhibiting the hinge dentition, becomes available the relationships of *Unio thulei* must remain in question. The holotype is deposited in the Sedgwick Museum, Cambridge, registration number F.15.705.

SUMMARY

Two new species of fossil freshwater mussels (Unionacea) are described, these being *Unio sewardi* and *Unio thulei* from the Cretaceous-Tertiary deposits of Antanikerdluk which is situated on the Nugssuak Peninsula, North Greenland. The holotypes of the two species are in the Sedgwick Museum, Cambridge.

PLATE XI

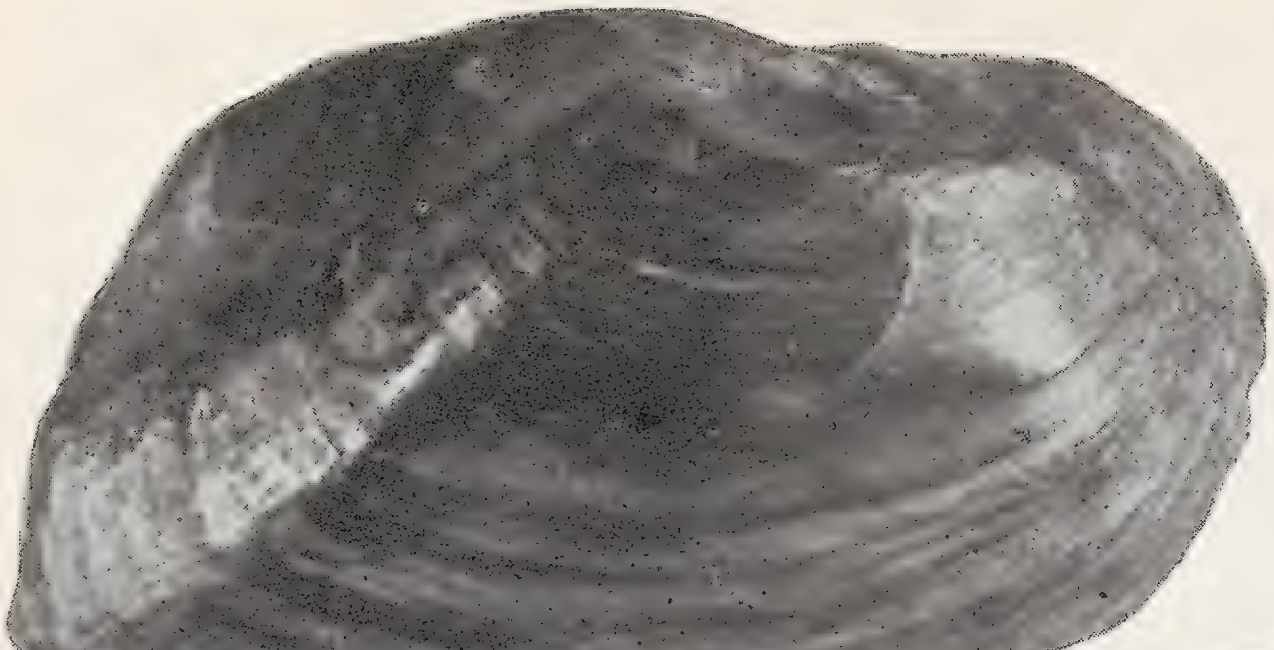


Fig. 1

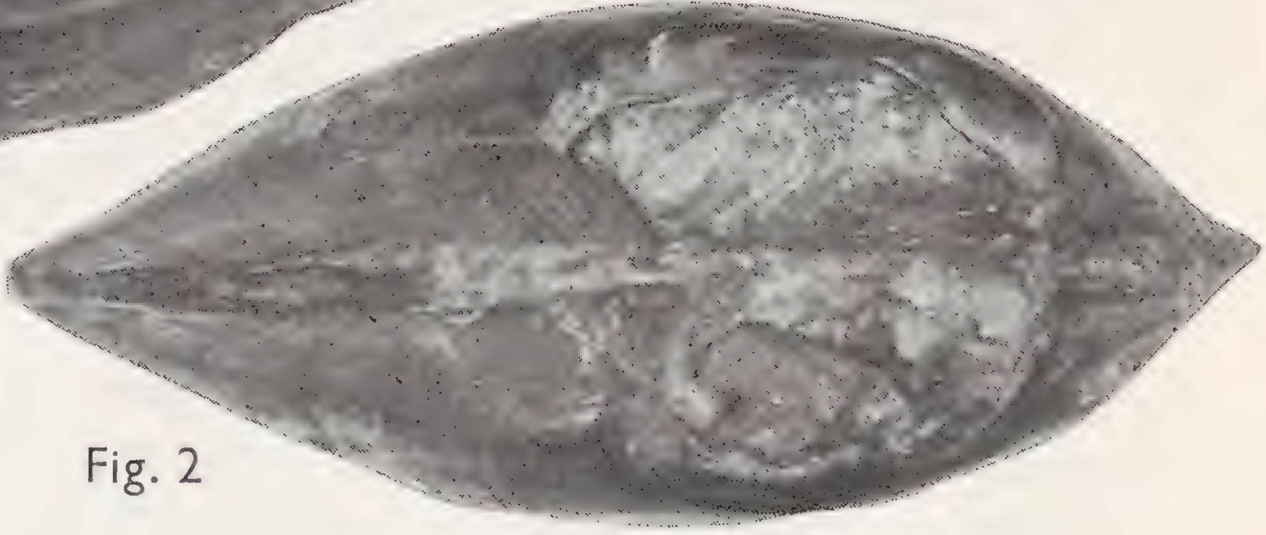


Fig. 2

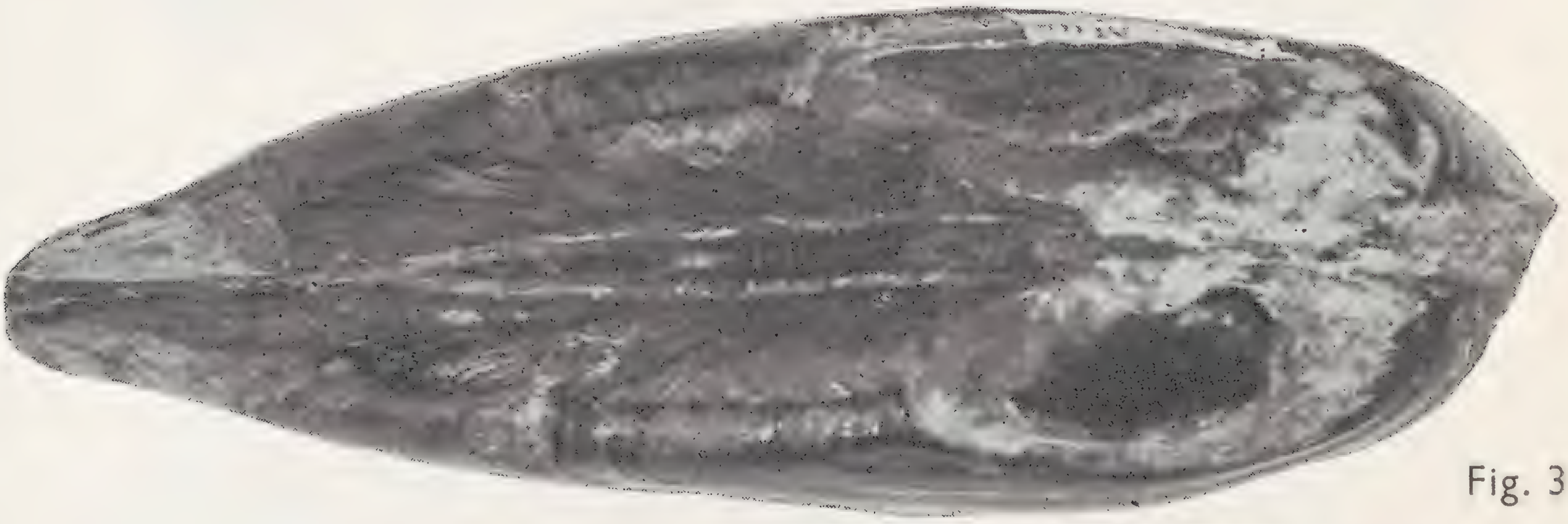


Fig. 3

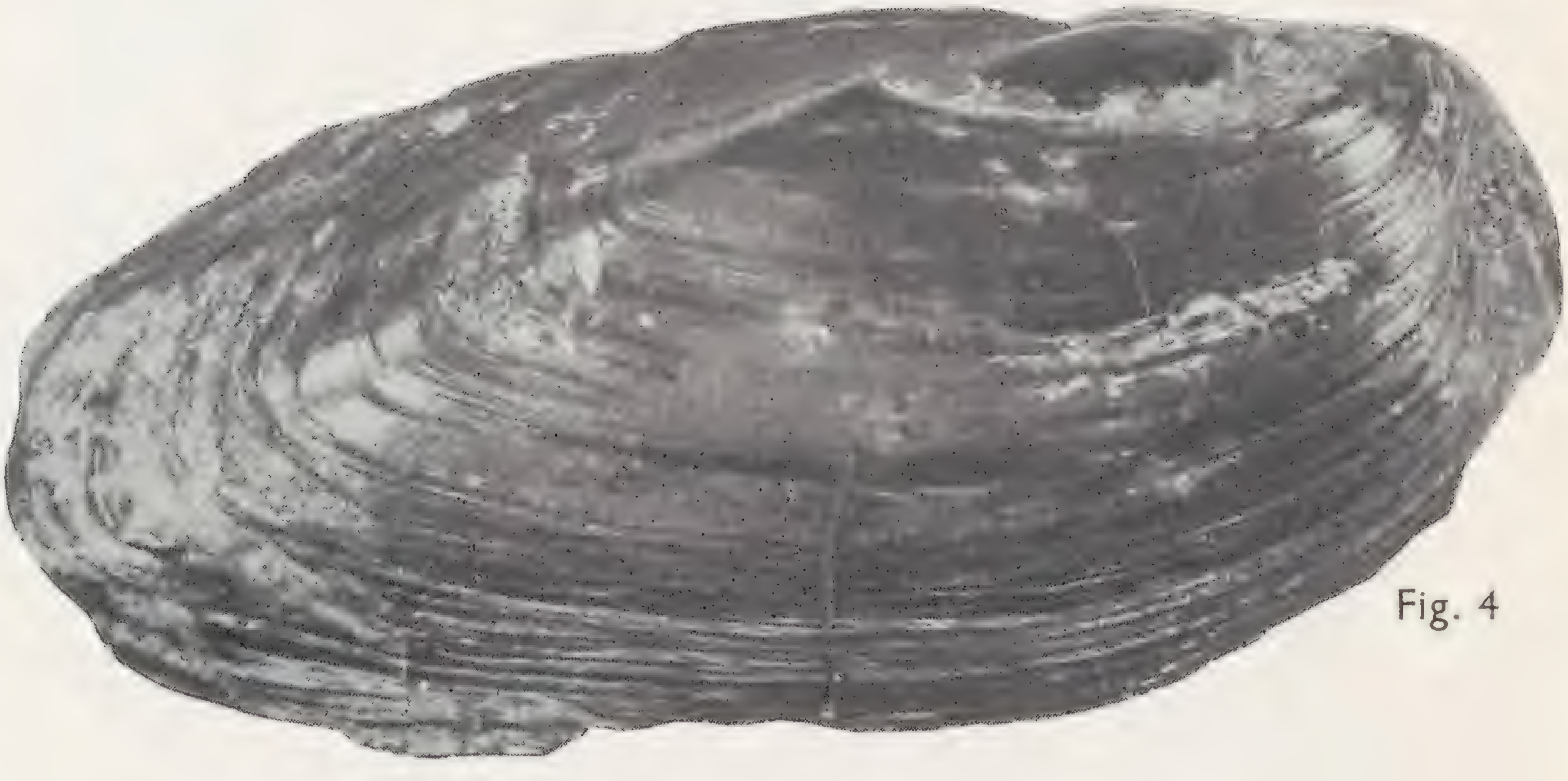
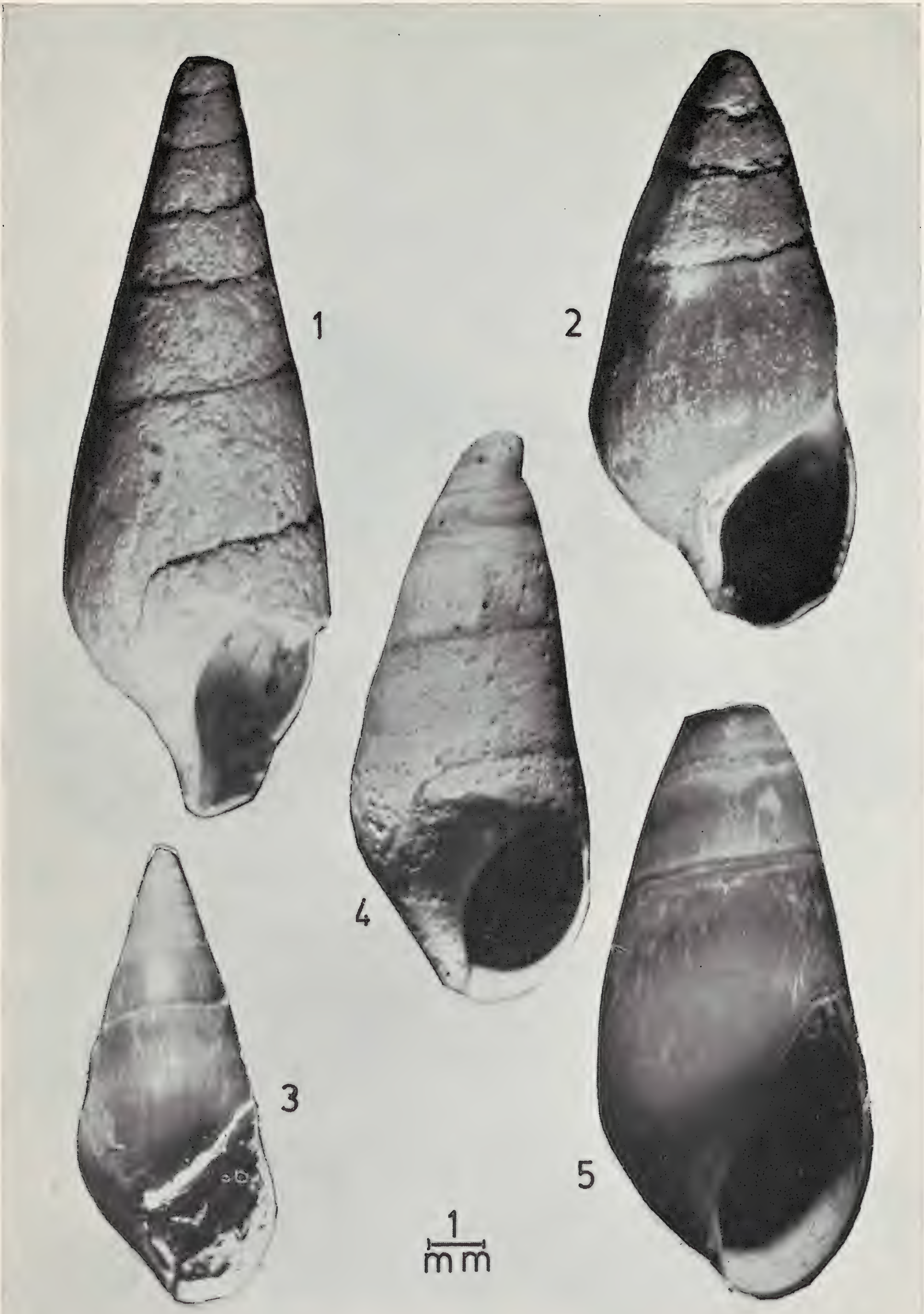


Fig. 4

Plate XIa



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Explanation of Plate XI

Fig. 1. *Unio thulei* Woodward, Holotype, lateral view.

Fig. 2. *Unio thulei* Woodward, Holotype, dorsal view.

Fig. 3. *Unio sewardi* Woodward, Holotype, dorsal view showing gonial plications.

Fig. 4. *Unio sewardi* Woodward, Holotype, lateral view.

Explanation of Plate XIa

Fagotia acicularis (Ferussac)

(1) From Kalbsrieth, in the same state as the specimens from Edersleben and Zeuchfeld figured by Wust.

(2) From the upper (Mindel) stratum of the calcareous tufa of Vertesszollos, intact but bleached.

(3) From the early Wurm calcareous tufa of Tata, intact and less bleached than no. 2.

(4) "Subfossil", from the Danube sand of Bata, broken, worn and eroded, in the same state as those from Thuringia as well as marine tertiary shells from the same sand-sample.

(5) From the same sample as no. 4, broken and worn, but not altogether bleached and not eroded, evidently not so old.

All specimens ca x 7, 7 enlarged.
Phot. Elke Knauff, Weimar.

Photographs by R. F. Cumberland.

J. Conch. *27*: 272 (1971)

TELLINA SERRATA BROCCHI A BRITISH SPECIES

Nora F. McMillan
The Nook, Uplands Road, Bromborough, Cheshire.

(*Read before the Society, 16 May 1970*)

Tellina serrata Brocchi is not included in Winckworth's List of the British marine Mollusca (1932), yet J. T. Marshall (1897) dredged two fresh valves off the Menavawr, Scilly, in 40 fm. and commented "both valves quite fresh . . . and I have no doubt whatever that the species is to be found among the Scilly Isles".

I possess a single complete specimen, quite fresh, (size 25 mm. high and 35 mm. long) given to me by Mrs. Gladys Fowler with other shells from the collection of her husband, the late William Fowler. Mr. Fowler, an old friend of mine, lived in Sennen, Cornwall, for many years and did much collecting in Scilly but he did *not* collect anywhere outside Britain.

My specimen is unlabelled but associated with a valve of *Tellina balaustina* and in a letter from Mr. Fowler to me (dated Jan. 15, 1952) he refers to his having dredged a valve of *Tellina balaustina* off Scilly. This is such a rare species that it seems reasonable to assume that (1) the *T. balaustina* valve boxed with the *T. serrata* specimen came from Scilly, and (2) that the *T. serrata* also came from Scilly, although there is no direct proof of either assumption.

Nordsieck (1969) gives the distribution of *T. serrata* Brocchi (sub *Quadrans* (*Striotellina*) *serrata* Brocchi 1814) as Mediterranean and from the Canaries to the Atlantic coast of France.

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J. Conch. *27*: 273–276 (1971)

OBITUARY

Captain Cyril Diver, C.B., C.B.E., died on Monday February 17th 1969, aged 76.

Cyril Diver was born in 1892, the son of Lt. Col. C. Diver and Maud Diver the novelist and writer on British India. Educated at Dover College and Trinity College, Oxford, he served in France during World War I. Professionally he was Clerk of Committees at the House of Commons. In 1948 he was appointed to be the first Director-General of the Nature Conservancy, but though he had a distinguished career his greatest interest lay in the field of natural history, especially in molluscan ecology and genetics.

By kind permission of Sir Julian Huxley we reprint his tribute to Captain Diver, published in *The Times* of 28 February 1969, and follow it with an appreciation by Professor A. J. Cain.

THE EDITOR

CAPT. CYRIL DIVER

START OF NATURE CONSERVANCY

Sir Julian Huxley writes:—

When I was invited in 1945 by the Minister of Town and Country Planning to get together a Wild Life Conservation Special Committee for England and Wales to make proposals for the conservation of nature, Cyril Diver was naturally one of those to whom I looked for aid. Although professionally a clerk in the service of Parliament, he never disguised the fact that his first allegiance was to nature, and his remarkable personal survey of Studland had distinguished him as an outstanding ecologist.

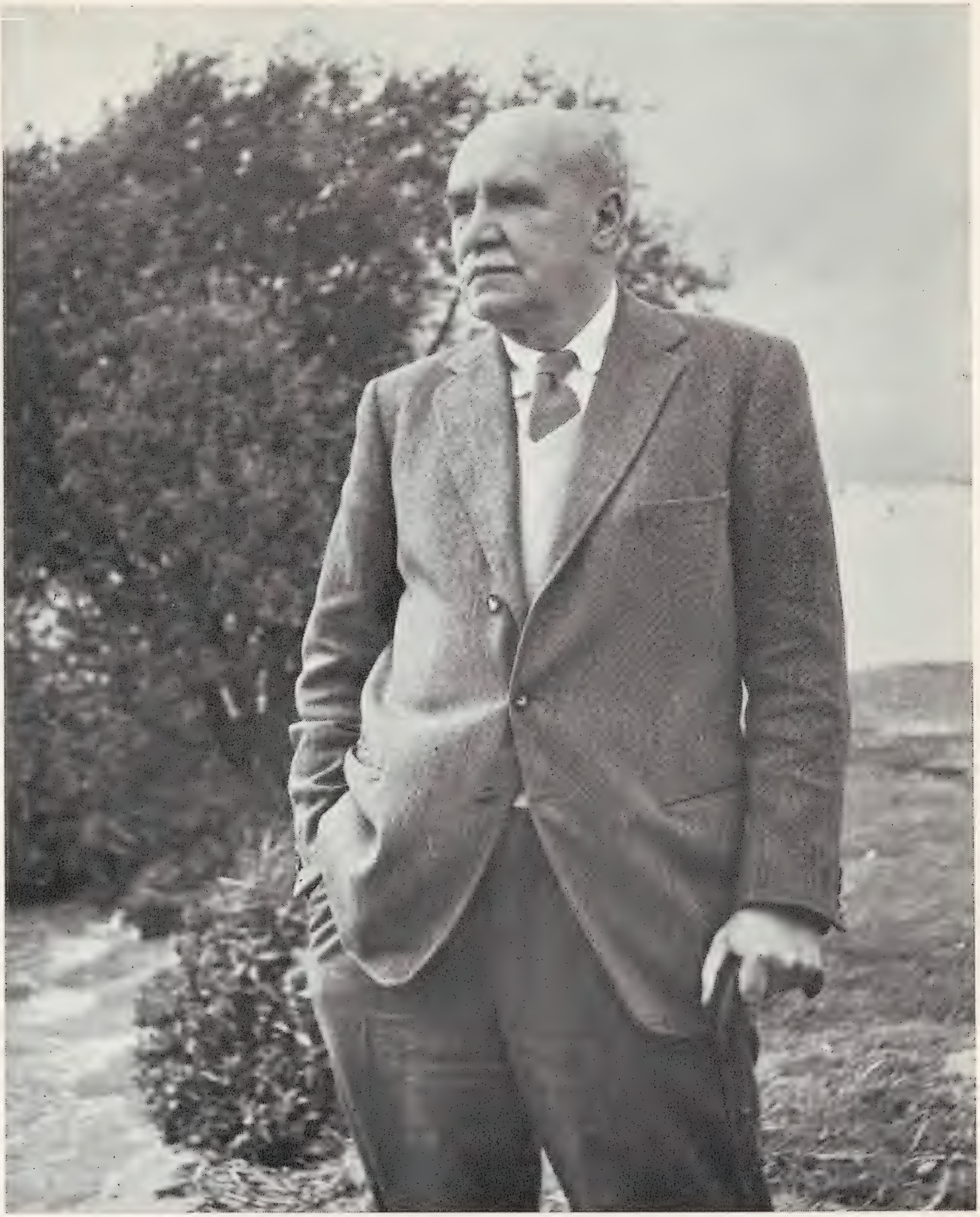
On the committee, which made up a first-class team, he soon distinguished himself by his passion for thoroughness, his almost inexhaustible appetite for work between sessions, and his readiness to take away a tangle of facts and opinion and to bring back a cogently stated and usually acceptable draft. As every chairman knows, such men are rare. Although his fellow-members made valuable contributions, I believe they would agree that Cyril Diver's dedicated perseverance and his talent for drafting and revision were decisive in producing the memorable Command Paper 7122, which was adopted virtually *en bloc* by the Government and by Parliament in setting up the Nature Conservancy, of which he became the first Director-General laying the guide-lines for future policy.

As an old friend and colleague, may I be allowed thus briefly to record a public service for which many people have cause to be deeply grateful.

I met Captain Cyril Diver, a few years after the war, in London at meetings of the Council of the Systematics Association, of which he was one of the founders.

It had been started so that people deeply interested in modern population genetics, ecology and taxonomy could have meetings and discussions—a highly desirable object, and hardly attainable within the Linnean Society in those days. One of its first fruits was the excellent volume *The New Systematics* (1940) edited by Julian Huxley, the profits from which went to the Systematics Association. Diver impressed me immediately both by his outstanding personality (vigorous and, to use that sadly dilapidated word, genial) and his extreme efficiency in conducting meetings. He was immediately interested to hear of the work Philip Sheppard and I had started on *Cepaea* and disagreed sharply with our conclusions. We had several verbal fights about it, which we both thoroughly enjoyed and knew the other was enjoying; his trump card was always the remark "Go to Bundoran. Until you've seen the variation there, you haven't seen much of *Cepaea*." He was always firm that it was completely random, non-adaptive, and correlated with no feature of the local environment. He was widely and rightly regarded as the best living authority on variation in snails. I had already read with respect his paper in *The New Systematics* on closely related species in the same area, and when I started to study his other work, it was clear that his reputation was fully justified. His superb presidential address to the Conchological Society on 15 Oct. 1938 on *Aspects of the study of variation in snails* (published March 1939) can still be read with both profit and pleasure, and many years later it impressed some of my pupils with a vivid sense of Diver's great capacity. He was one of the principals, with Boycott, in the classic work on the inheritance of sinistrality in *Limnaea* which appeared in various papers from 1923 to 1938. He was perhaps the first to appreciate the importance to geneticists of fossil records of genetic variation (in *Cepaea, Nature* 1929). He was certainly one of the first to realise the immense importance of virtually inch-by-inch mapping of the plant carpet in surveys of the distribution of animals, and it is very sad that the results of the Studland survey, begun in 1932, were never published. (I shudder to think what he would have said of some so-called surveys purporting to be ecological, published long after his work in reputable journals). At least as important was his realization (following Boycott and Alkins) of the importance of the random sample. It is difficult to know who among that outstanding group of conchologists Boycott, Diver, Oldham and Stelfox, started any particular idea first; but Diver's brilliant advocacy of the random sample to conchologists still very much wedded to picking out cabinet specimens or named varieties, and the fact that he had already started collecting random samples of *C. hortensis* and *nemoralis* in 1920 suggests that it was as much his idea as anyone's. His industry was fantastic. He and Boycott in 1924 collected from the Bundoran sand-dunes alone about 25,000 *C. nemoralis*; and in his *New Systematics* paper he mentions over 27,000 other *C. nemoralis* and nearly 25,000 *hortensis,* mainly from England. He drew the right conclusions from this mass of data and from his and Boycott's magnificently detailed survey of *Cepaea* on the Berrow dunes—namely the extreme patchiness of distribution of these and most other animals, the considerable amount of inbreeding there must be, and the vast number of evolutionary units that a so-

Plate XII



Capt. Cyril Diver (1892-1969)

called widespread species is broken into, over even a small area of country. He was thoroughly up to date in his reading, his knowledge of the relevant genetics and ecology was excellent, his practical experience vast, and in short he had a grasp of the subject that many a professional student of evolution at that time might envy. In this he was helped by personal contact with some of the most distinguished evolutionists of his day; he was closely associated with Julian Huxley, he published with Sir Ronald Fisher on genetical crossing-over in *Cepaea*, and he saw the proofs of E. B. Ford's celebrated paper on polymorphism in 1939. He was keenly critical of his own work, and this attitude, combined with the enormous masses of data that he collected, resulted in his publishing far less than he might have done with perfect propriety (not just for the sake of "getting papers published," an activity he would have hated and despised).

In one respect, he was the victim of his own outstanding qualities. In his surveys of *Cepaea*, as already said, he was a brilliant pioneer, collecting random samples carefully characterised according to habitat from all over England and adjacent countries, and scoring them with a knowledge of the genetics of the morphs included. When he put all his data together, he could find no association at all between habitat or geographical locality, and the occurrence or frequency of any particular variety. As his studies had shown him that these common species were divided up into numerous small colonies, either by actual uninhabited areas or by distance within an apparently continuous population, and as his detailed surveys at Berrow and Bundoran equally showed no correlation with any obvious features of the habitat, he very reasonably concluded that chance and Sewall Wright's "genetic drift" had played the principal part in bringing about the differences between *Cepaea* colonies. And this was an infinitely more respectable conclusion than that reached since by various eminent geneticists who with no practical knowledge whatever of the *Cepaea* situation have concluded that the variation must be due to chance because they personally can't see how it could be anything else. We know now that if he had restricted his collecting to smaller districts inland, he would have discovered either areas in which visual selection was operating, as many have found since in lowland Britain, or the extraordinary districts with comparative constancy of frequencies over large areas which cannot be due to chance, which Professor Currey and I have described as "area effects" and which are usual at higher altitudes in calcareous country. His excellent survey at Berrow was repeated 30 years later by Professors Bryan Clarke and J. J. Murray, who have shown there is a constancy of the pattern of variation which does not allow that chance can play a large part in determining varietal frequencies. With characteristic generosity he handed over to them all his samples and notebooks for the Berrow work, and later added those from Bundoran, and a massive paper by Clarke, Diver and Murray (*Proc. Roy. Soc. London* B 253 : 519-548) gives the results—again a general stability over many years inconsistent with chance. Diver contributed an appendix to this paper giving the history of his own interest in *Cepaea,* referring to earlier work, and reaffirming his own belief that chance events were of importance. What certainly can be said of his work in this respect is that even if he did not find an acceptable solution to the problem, it was as the result of his surveys that the problem was made precise and attackable by others; and as field workers know too well, it is often the definition of the problem which is the greatest triumph.

A. J. Cain

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THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1969

				£	s.	d.	£	s.	d.
Publications:									
Newsletter							338	13	0
Student Papers				150	9	6			
Less Transfer from Reserve and Research Fund				97	6	4			
							125	3	2
Journal:									
Volume 26 No. 5	348	13	3						
Authors Reprints	21	10	0						
				370	3	3			
Volume 27 No. 1	350	0	7						
Authors Reprints	16	0	3						
				366	0	10			
							736	4	1
Field Meetings							18	8	11
Meeting Expenses							11	13	3
Bank Charges							2	12	0
Printing, Stationery and Postage							124	5	8
Officers' Expenses							70	15	8
Subscriptions							8	7	6
							1,436	3	3
Net Surplus							178	17	2
							£1,615	0	5

	£	s.	d.	£	s.	d.
Fees and Subscriptions:						
Membership Fees	869	17	6			
Subscribers	283	14	2			
Entrance Fees	28	5	0			
				1,181	16	8
Donations				11	0	0
Sales:						
Advertising	17	0	0			
Journals	29	14	4			
Student Papers	40	1	9			
Newsletter	3	7	6			
Authors Reprints	23	16	0			
Sundry Receipts	5	10	6			
				119	10	1
Investment Income:						
General Account	257	5	11			
Life Members Fund	45	7	9			
Reserve and Research Fund	70	6	4			
	373	0	0			
Transfer to Reserve and Research Fund	70	6	4			
				302	13	8
				£1,615	0	5

BALANCE SHEET AS AT 31 DECEMBER 1969

				£	s.	d.
Fees and Subscriptions in Advance ...				164	10	9
Life Membership Fund				710	0	0
Reserve and Research Fund				1,100	0	0
CAPITAL ACCOUNT						
Balance Bt./Fwd. ...	4,025	2	10			
Add Surplus	178	17	2			
				4,204	0	0
				£6,178	10	9

	£	s.	d.	£	s.	d.
Cash at Bank: Current A/C	420	17	9			
Deposit A/C	1,384	14	8			
Cash in Hand	3	0	9			
				1,808	13	2
Investments						
£400 5% Treasury Stock 1986/89 (£257 0 0) ...	344	0	0			
£500 5¾% Deb. Stock Mersey Docks & Harbour Board 1976/78 (£372 10 0)	460	17	0			
£737 13 5 6¾% Stock Greater London Council 1976 (£639 18 9) ...	721	10	5			
2,514 Units M. & G. Dividend Fund (£1,422 4 7) ...	1,522	1	2			
£400 5⅝% Loan City of Norwich	400	0	0			
£800 5½% Loan London County Council ...	769	4	0			
420 Scotbor Income Units	152	5	0			
				4,369	17	7
				£6,178	10	9

Examined and found correct.
CHARLES PETTITT } Auditors.
ADRIAN NORRIS }

MARJORIE FOGAN
Hon. Treasurer
27th January 1970

J. Conch. *27*: 280–290 (1971)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

857th (ORDINARY) MEETING, 18 OCTOBER 1969

Communications. "A Note on the Faeces of *Agriolimax reticulatus*" by D. Pallant. "A Record of Slug Movements in Late Summer" and "A Note on Various Weeds as Food for *A. reticulatus*" both by D. M. Duval. "*Ensis* from the Firth of Forth" by Shelagh M. Smith. "Distribution of *Abida secale* in the North Cotswolds" by D. C. Long. "*Pisidium tenuilineatum* in Sussex" by M. P. Kerney.
Subject for Discussion. "Far Eastern Marine Shells", introduced with a talk on the shells of North Borneo, illustrated with coloured slides, by Mrs. M. Saul.

Member Deceased

Mr. Percy Elston of Cape Town, South Africa.

858th (ORDINARY) MEETING, 15 NOVEMBER 1969

Comunications. "*Adula simpsoni* in Shetland" by Mrs. N. F. McMillan. "Bibliography of the Molluscan Writings of J. R. Bourguignat" and "*Pisidium lilljeborgi* in the River Teifi" by S. P. Dance.
Subject for Discussion. "Mollusca of Ireland", introduced with a talk on "Some Irish Naturalists" by Mrs. N. F. McMillan.

Members Elected

G. E. Crisp, B.Sc., C.Eng., 31 Lismoyne Park, Belfast, BT1 5HE, Ireland.
F. C. Curle, 100 North Road, Westcliffe-on-Sea, Essex.
P. M. Deeley, 36 Falfield Road, Lower Tuffley, Gloucester, GL4 0NE.
D. K. Glister, Farthing Green Lane, Stoke Poges, Bucks.
Mrs. M. Grier, R.G.N., S.C.M., Dervaig, Longisdan Road, Oban, Argyll, Scotland.
B. Hammond. B.Sc., 9 Goffs Lane, Cheshunt, Herts.
Mrs. E. Harrison, 12 Cardigan Close, Macclesfield, Cheshire, SK11 8QG.
Mrs. M. D. Hempseed, 16 West Chapelton Drive, Bearsden, Dumbartonshire.
Mrs. M. A. Hodgson, Flat 2, 51 Onslow Square, London S.W.7.
A. N. Insole, 106 Cotham Road, Bristol 6.
W. Johnson, 99 Drayton Terrace, Wynnum Central, Brisbane, Queensland, Australia 4178.
A. G. H. Lewis, 30 Gorwydd Road, Gowerton, Swansea, S. Wales.
J. W. McNab, B.Sc., B.P. Refinery (Aden) Ltd., P.O. Box 3003, Aden, P.R. of South Yemen.
M. de Munter, IUTOM, 1040 Chausée d'Alsemberg, Brussels 18, Belgium.
G. N. Myers, 30 Marsworth Avenue, Pinner, Middlesex.
R. T. Pemberton, Ph.D., 28 Maude Avenue, Baildon, Shipley, Yorks.
RIVON (Nat. Inst. for Nature Conservation Research), Laan van Beek en Royen 40–41, Zeist, Netherlands.
P.R. Rofen, Ph.D., Aquatic Research Institute, P.O. Box 648, Stockton, California 95201, U.S.A.
P. J. C. Russell, Ph.D., Marine Laboratory, Ferry Road, Hayling Island, Hants., PO11 0BG.

D. E. Seaward, B.Sc., 3 Summerlands, Yeovil, Somerset.
B. C. Shurlock, M.A., Ph.D., 15 Willow Court, Ryton, Co. Durham.
I. F. Smith, B.A., 1 Sandringham Road, Bredbury, Stockport, Cheshire.
J. V. Smith, Flat 1, Victoria Court, May Bank, Newcastle, Staffs.
A. I. B. Spencer, 529 North Darlington Street, West Chester, Pennsylvania 19380, U.S.A.
Mrs. S. Whybrow, A.S., B.A., 2 Ridge Street, New Haven, Connecticut 06511, U.S.A.
Miss M. Williams, Twmpath, Morfa Nefyn, Pwllheli, Caernarvonshire.
A. J. Woodruff, 9 Netherby Road, London S.E.23.

859TH (ORDINARY) MEETING, 13 DECEMBER 1969

Communication. "The British distributions of *Monacha cantiana* and *M. cartusiana* in the British Isles" by Dr. M. P. Kerney.
Subject for Discussion. "Non-Marine Mollusca of New Zealand", introduced by Mr. T. E. Crowley in place of L. W. Stratton who was unable to attend through illness.

MEMBERS ELECTED

The Keeper of Natural History, Natural History Museum, High Street, Colchester, Essex.
J. H. Crothers, M.A., The Leonard Wills Field Centre, Nettlecombe Court, Williton, Taunton, Somerset.
P. H. Hodgson, 51 Onslow Square, London S.W.7.
Miss P. S. Leighton, 2 Greenacre Road, Woolton, Liverpool 25.
J. D. Peacock, B.Sc., Ph.D., 40 Queen's Park Court, 46 Lilyhill Terrace, Edinburgh.
Miss Catherine Ridler, 76 Church Road, Teddington, Middlesex.

860TH (ORDINARY) MEETING, 31 JANUARY 1970

Communications. "The Importance of Mineral Particles in the Diet of *Limnaea pereger* (Müller)" by R. Storey. "A Preliminary Account of the Distribution of *Cepaea* Species in the Nettlecombe District, Somerset" by C. R. Bantock. "Snail Shells under Starling Roosts" by the Earl of Cranbrook, C.B.E. "Non-Marine Molluscs of Borneo, 1. *Streptaxacea*" by S. P. Dance.
Subject for Discussion. "Placostylus", introduced by Mr. T. Pain.

MEMBERS ELECTED

Mrs. S. A. Dressler, 8035 Gauting bei Munich, Margaretenstr. 1, Germany.
Drs. E. Gittenberger, Rijksmuseum v. Natuurlijke Histoire, Raamsteeg 2, Leiden, Netherlands.
R. W. Piddock, T.A.S.F., R.A.F., Akrotiri, B.F.P.O. 53, Cyprus.

861ST (ANNUAL GENERAL) MEETING, 28 FEBRUARY 1970

In the Chair, the President, Dr. B. Verdcourt, and 46 members and friends present. Dr. Verdcourt gave his Presidential Address—"Some Pioneer Snail Hunters in East Africa."
Election of Auditors. Mr. W. F. Edwards was elected and Mr. C. W. Pettitt was re-elected.
Election of Officers for 1970/71. President: Mr. T. Pain. Secretary: Miss J. T. Sawyer. Treasurer: Mrs. M. Fogan. Editor: Mrs. N. F. McMillan. Non-Marine

Recorder : Dr. M. P. Kerney. Marine Recorder : Mrs. S. M. Turk. Council Members : Miss J. Chatfield, Mr. T. E. Crowley, Mr. P. E. Negus, Mr. A. Norris, Mr. A. P. H. Oliver, Mr. D. G. Pickrell.

MEMBERS ELECTED

Miss O. P. Byrne, Digby Stuart College, Roehampton Lane, London S.W.15.
Miss F. M. Davies, B.Sc., Department of Zoology, Royal Holloway College, Alderhurst, Bakeham Lane, Englefield Green, Surrey.
I. K. Dawson, 43 Haddon Road, Lillington, Leamington Spa, Warwicks.
R. Dixon, B.Sc., Bockleton County Study Centre, Tenbury Wells, Worcs.
K. S. Erskine, L.D.S., 45 Grove Walk, Norwich, Norfolk NOR 95D.
Mrs. B. Green, 143 Auckland Road, Ilford, Essex.
B. Justin, A.R.I.C., Ph.D., 51 St. Anne's Road, Widnes, Lancs.
B. F. Keegan, B.Sc., M.Sc., Zoology Department, University College, Galway.
E. J. Redshaw, Rowanhill, 7 Fennell Road, Pinchbeck, Spalding, Lincs.
Dr. N. Ruiz Martin, Dr. Sanchez Cozar s/no, 1º Dcha, Granada, Spain.
D. Slimming, c/o Seychelles College, Mont Fleuri, Mahé Seychelles.
Sea Gem Enterprises, Waterville, Co. Kerry, Ireland.
B. J. Smith, B.Sc., Ph.D., Curator of Invertebrates, National Museum of Victoria, Russell Street, Melbourne, Victoria, Australia 3000.

ANNUAL REPORT OF THE COUNCIL 1969–1970

Membership. The Society has to deplore the loss by death of five members, namely Captain Cyril Diver (Past President), Mrs. Morehouse and Messrs. Lopez Socas, Percy Elston and A. G. T. Evans. Resignations were received from 13 members and 10 were removed from the lists for non-payment of subscriptions.

Newly elected members, including juniors transferred to ordinary membership during the year, totalled 61, resulting in a net gain of 33 compared with 31 last year. Present membership stands at 465 including 16 life and 3 honorary members but not including juniors.

Meetings. One Annual and seven Ordinary meetings have been held at the British Museum (Natural History), by kind permission of the Trustees, that held in April being a very successful joint meeting with the Malacological Society of London. The average attendance at meetings was 46, about the same as last year, and the attendance of 64 in October is a record for the Society.

Publications. An issue of the *Journal of Conchology* dated October 1969 was published, and under the present Editor, a considerable speed-up in the production of Journals is taking place. *Conchologists' Newsletters* were issued, Nos. 28 to 31, quarterly as usual. Two *Papers for Students* were issued, and members also received an annual membership listing and a syllabus.

T. E. CROWLEY,
Hon. Secretary

TREASURER'S REPORT, 1969

Once again the Society's income has shown a slight upward trend, with increases in receipts from members' subscriptions. *Journal* subscribers and sales (provided that the final large payment for *Journal* back numbers, and the sale of the stock of *Link Beschreibung*, both unusual features of the previous year, be excluded). The figure for the current members' subscriptions includes the sum of £36 10s. 2d. which was received through the seven-year covenants of 26 members. Over 40 covenants are in force for 1970, and it is hoped that more members will take advantage of this method of paying their annual subscriptions.

During the year the Society's investments were increased by the purchase of £165 Greater London 6¾% 1976 Stock and 420 Scotbor Income Units, both for the benefit of the General Account. The large increase in the investment income is, however, due in a large degree to the unusually high interest earned by the Deposit Account.

As I mentioned in my Report for 1968, the then figure for the Deposit Account included the unspent allotment for two *Journal* parts, namely Vol. 26 Parts 5 and 6. Since the first of these parts was not paid for until August 1969, and the second has not yet appeared, the balance in the Deposit Account throughout the year has remained unusually high and the amount of interest accruing cannot be regarded as an accurate guide for the future. It must also be made absolutely clear that the large balance at present shown in the Deposit Account gives a somewhat false picture of the assets of the Society; this must not be looked upon as an available asset, since the greater portion is already earmarked to cover the costs of the *Journal* Vol. 26 Part 6, the index to Vol. 26, and Vol. 27 Part 2 (now in the press) also the Society's film. When the position is finally clarified it is hoped to be able to recommend a further increase in the investments.

Sales of *Students Papers* have again increased, mainly due to the work of Mr. Biggs, and they are achieving a good deal of respect in academic and educational circles. The increased demand necessitated the reprinting of several papers, and the Council authorised the use of the 1969 income from the Reserve and Research Fund for this purpose.

The Treasurer's thanks are due to members, who in 1969 proved on the whole to be very prompt in payment of annual subscriptions. Only 9 are in arrears.

Unfortunately, costs show no signs of decreasing. Duplicating has become more expensive, as is shown very clearly in the costs of the *Newletter*, and it appears virtually certain that postal charges will be raised again. All members can help by prompt payment of subscriptions, since the cost of sending reminders can be quite heavy, and all who are eligible to do so are urged to consider paying their subscriptions by seven-year covenant.

1971 will see the introduction of decimalisation, and it may be that this will involve the alteration of the prices of some publications, etc. Members are asked to appreciate that where increased prices result this is not a case of attempted profiteering but is due to the impossibility of reducing prices below cost.

MARJORIE FOGAN,
Hon. Treasurer

FIELD MEETINGS

Ten field meetings were held during 1969 as follows: 29 March, East Glamorgan. 27 April, Herne Bay, Kent. 9–11 May, Charmouth and Lyme Regis, Dorset (joint meeting with the Croydon Branch, British Sub-Aqua Club). 31 May, Leicester area. 22 June, Walton-on-the-Naze, Essex. 13 June, Dover and Deal, Kent (joint meeting with the Kent Field Club). 17 August, Hurst Castle Spit, Hants. 21 September, Northampton area (joint meeting with the Northampton Natural History Society). 5 October, Bix Bottom, near Henley, Oxon. 25 October, Chippenham, Wilts. In addition, the following meetings were organized by the North-West Mollusca group: 13 April, Upton-by-Chester. 3 May, Manchester canals. 10 May, Holden Clough, near Oldham. 18 May, Loggerheads, North Wales (joint meeting with the Liverpool Naturalists' Field Club). 14 June, Tatton Park, near Knutsford, Cheshire. 28 June, Freshfield, S. Lancs. 27 July, Barnaby Sands, W. Lancs. 2 Sept. Brockholes gravel pit, near Preston. 20 September, Chaigley, Lancs. 8 November, Rufford and Tarleton, S. Lancs.

Thanks are due to the following for leading these meetings: Mrs. M. Fogan, Mrs. J. Kline, Mrs. N. F. McMillan, Miss J. E. Chatfield, Dr. B. Verdcourt, and Messrs. S. P. Dance, G. Dinesen, I. M. Evans, W. F. Edwards, E. F. Greenwood, J. Llewellyn-Jones, A. R. Lord, R. A. Martin, G. Osborn, E. Philp, D. G. Pickrell, A. J. Rundle and M. J. Wilding.

Details of many of these meetings appear in the *Conchologists' Newsletter*. Field meetings are also held by the Society's Yorkshire Branch.

T. Pain

RECORDER'S REPORT: NON-MARINE MOLLUSCA

A. 10-Kilometre Square Mapping

Fairly good progress was maintained in 1969. Another 11,000 records have been incorporated, bringing the post-1950 total up to about 56,500. It is hoped that it will be possible to produce an atlas by 1974, allowing four more field seasons for the collection of data. For certain species, for example those with mainly south-eastern distributions, reasonably good maps can already be constructed, but a great deal more recording is needed before it will be possible to do this for so-called "common" species. Vast tracts in the north and west of the British Isles still remain unvisited by any conchologist.

B. Vice-County Records

The following new records have been verified since the last Recorder's report (*J. Conch.*, **27** : 53). Unless otherwise stated, the date of collection was 1969. A 1-kilometre square grid reference (if available) is attached to each record.

Cornwall East (2) : *Pisidium hibernicum*, Tamar Reservoir, Kilkhampton (21/2911), M. R. Block, 1967.

Somerset South (5) : *Pisidium pulchellum*, Thorney (31/4523), D. R. Seaward.

Wilts North (7) : *Vertigo pusilla*, Leigh Delamere (31/8979); *Pisidium supinum*, R. Avon, Lacock (31/9268). both S. P. Dance.

Sussex West (13) : *Pisidium tenuilineatum*, Harting Pond, South Harting (41/7822), M. P. Kerney.

Sussex East (14) : *Lauria anglica*, Balcombe (51/3130), I. D. Finney; *Vertigo substriata*, Balcombe (51/3130); *Vitrina major*, Balcombe (51/3128); *Agriolimax caruanae*, Balcombe (51/3030), all M. P. Kerney.

Kent East (15) : *Vallonia pulchella*, Sandwich (61/3557), E. G. Philp; *Pisidium moitessierianum*, R. Stour, Sarre (61/2763), M. P. Kerney.

Bucks (24) : *Vertigo antivertigo*, Great Linford (42/8542), M. P. Kerney.

Suffolk East (25) : *Pisidium supinum*, R. Waveney, Homersfield (62/2885), D. C. Long.

Monmouth (35) : *Acicula fusca*, Great Llanmellin (31/4593); *Segmentina complanata*, Goldcliff (31/3782); *Agriolimax caruanae*, New Tredegar (32/1403), all S. P. Dance.

Worcester (37) : *Hygromia limbata*, Castlemorton Common (garden; 32/7839) and Little Malvern (garden; 32/7741), both Mrs. M. Saul.

Warwick (38) : *Valvata cristata*, R. Leam, Offchurch (42/36), M. W. Rowe; *Acicula fusca, Vertigo antivertigo*, Bracebridge, Sutton Park (42/0998); *Vertigo substriata, Lauria anglica*, Blackroot Bog, Sutton Park (42/1097), all H. Overton, 1898 (Birmingham City Museum).

Stafford (39): *Pisidium moitessierianum,* Trent & Mersey Canal, Weston (33/92), R. C. Preece.

Salop (40): *Planorbis laevis,* Soudley (32/4791), H. H. Shephard, 1954.

Glamorgan (41): *Planorbis laevis,* Eglwys Nunnid Reservoir (21/7984); *Vitrina major,* Radyr (31/1180); *Limax tenellus,* Garth Wood, Pentyrch (31/1182); *Pisidium pulchellum,* Tennant Canal, Tonna (21/7799), all S. P. Dance.

Brecon (42): *Lauria anglica,* Coed-y-croftau (32/0323); *Oxychilus draparnaudi,* Pen-y-cae (22/8414), both S. P. Dance.

Radnor (43): *Marpessa laminata,* Old Radnor (32/2457), H. H. Shephard, 1951; *Cecilioides acicula,* Llanstephan House (32/1141); *Zonitoides excavatus,* Newbridge-on-Wye (32/0061); *Zonitoides nitidus,* Llan Bwch-llyn (32/1146); *Agriolimax caruanae,* Llowes (32/1942), all S. P. Dance.

Carmarthen (44): *Lauria anglica,* Cenarth (22/2640); *Agriolimax caruanae,* Llysnewydd (22/3540); *Pisidium obtusale,* Talley (22/6333); *Pisidium lilljeborgi, P. hibernicum, P. nitidum,* River Teifi, Llanybyther (22/5244), all S. P. Dance; *Milax budapestensis,* west of Llandeilo (22/52), Miss June Chatfield.

Pembroke (45): *Lymnaea auricularia,* Orielton Decoy (11/9599), Dr. Larch Garrad.

Cardigan (46): *Lymnaea palustris,* Nantydderwen (22/6657); *Planorbis contortus,* Lampeter (22/5649); *Milax budapestensis,* Aberffrwd (22/6677); *Limax flavus* (dark form), Midroilyn (22/4656); *Pisidium lilljeborgi,* Pont Einon, Tregaron (22/6761), all S. P. Dance; *Agriolimax circumscriptus* (form *silvaticus*), *Oxychilus helveticus, Agriolimax caruanae,* Tal-y-bont (22/6488); *Milax sowerbyi,* New Quay (22/3859), all Miss June Chatfield.

Montgomery (47): *Milax budapestensis,* Abermule (32/1695), S. P. Dance.

Merioneth (48): *Menetus dilatatus,* Llyn Trawsfynydd (23/7034); *Acanthinula lamellata,* Torrent Walk, Dolgellau (23/7518), both S. P. Dance; *Agriolimax caruanae,* Barmouth Junction (23/6314), Miss June Chatfield.

Leicester (55): *Pyramidula rupestris,* Essendine, Rutland (52/0213), Mrs. E. B. Rands.

Derby (57): *Potamopyrgus jenkinsi,* Tideswell (43/17), Miss June Chatfield; *Monacha cantiana,* Cromford (43/3056), D. J. Cranmer; *Agriolimax laevis,* Millers Dale (43/17), Dr. L. Lloyd-Evans.

York Mid-west (64): *Helicella gigaxi,* Boston Spa (44/44), A. H. Lowman Newstead, 1890 (British Museum collection).

York North-west (65): *Vertigo pusilla,* Jervaulx Abbey (44/1785), Dr. L. Lloyd-Evans; *Vitrea diaphana* (form *subrimata*), Redshaw Moss (34/8084), Mrs. M. Fogan.

Kirkcudbright (73): *Lauria anglica,* Cardoness (25/5654), Mrs. E. B. Rands; *Pupilla muscorum, Vallonia costata, V. excentrica,* Brighouse Bay (25/6345), Dr. J. O'N. Millott; *Agriolimax agrestis,* by Clatteringshaws Loch (25/5475), E. Blezard.

Stirling (86): *Monacha granulata,* Cumbernauld Glen (26/7775), A. McG. Stirling, 1968.

Aberdeen South (92): *Hydrobia ulvae,* Aberdeen (38/90), before 1900 (City of Liverpool Public Museums).

Aberdeen North (93): *Helicella virgata,* Inzie Head (48/0662), E. Kellock.

Westerness (97): *Agriolimax agrestis,* by Pattock River, Loch Laggan (27/58), E. Kellock; *Pisidium personatum,* Inchlaggan, Glen Garry (28/1701); *Pisidium subtruncatum, P. hibernicum,* Aldernaig Burn, Glen Garry (28/2902), all Dr. Shelagh Smith.

South Ebudes (102): *Margaritifera margaritifera,* Lealt Burn, Jura (16/6693), J. Mercer, 1970.

North Ebudes (104) : *Oxychilus draparnaudi*, Raasay House (18/5436), Dr. Larch Garrad; *Pisidium subtruncatum*, *P. hibernicum*, Loch Cill Chriosd, Skye (18/6120), Dr. Shelagh Smith.

Ross West (105) : *Hygromia hispida*, Ullapool River (28/19), Mrs. J. A. Paton.

Caithness (109) : *Pisidium milium*, *P. pulchellum*, Crosskirk (39/0369), Mrs. E. B. Rands.

Waterford (H 6) : *Milax budapestensis*, Kilmacthomas (S 3705), Mrs. M. Fogan.

Galway West (H 16) : *Agriolimax caruanae*, Inishshark (L 46), R. O'Connor, 1968.

Westmeath (H 23) : *Anodonta anatina*, Rinardoo Bay, Lough Ree (N 0548), *per* Mrs. A. M. Brockbank.

Longford (H 24) : *Limax flavus* (dark form), Island Bridge, Keenagh (N 1163), Miss June Chatfield, 1968.

Sligo (H 28) : *Marpessa laminata*, Slish Wood, Lough Gill (G 7432), Mrs. J. A. Paton.

Fermanagh (H 33) : *Limax flavus* (dark form), Carrickreagh, Lower Lough Erne (H 1752), Miss June Chatfield, 1968.

Donegal East (H 34) : *Ena obscura* (dead shell), Soldier's Hill, Malin (C 4253), Mrs. J. A. Paton.

The following segregates of *Carychium*, *Cochlicopa* and *Vitrea* have also been verified :

Carychium minimum : 48.
Carychium tridentatum : 47.
Cochlicopa lubricella : 7, 35, 93.
Vitrea crystallina : 47, 48, 101.
Vitrea contracta : 30, 31, 48.

The following records are to be deleted from the Census. No confirmation for them can be traced :

Acicula fusca : H 23 (132), H 32 (117).
Helicella gigaxi : 81.
Cochlicella acuta : 72, H 32 (117), H 37 (116).

The past year has seen a number of interesting records. *Vitrea diaphana* has been found some 11 miles north of the site of its original discovery near Austwick (*J. Conch.* **27** : 17), and will probably turn out to be widespread, if local, in suitable habitats in the north Pennines. A very isolated station of the north-western oceanic species *Lauria anglica* has been discovered at Balcombe in Sussex. The habitat is a marshy alder wood in the bottom of a valley in acid Wealden sandstones, where it is associated with *Vertigo substriata* and *Zonitoides excavatus*. *Lauria anglica* is known from geological evidence to have been common in the south-east in the earlier part of the Postglacial period, and the Balcombe locality is almost certainly a relict from this time. Steps have been taken to have the site protected. *Pisidium tenuilineatum* in west Sussex is probably also a Postglacial relict; this is the first time that the thin-shelled form of the species has been found alive in Britain, although it has occurred fossil (*J. Conch.* **27** : 115).

A surprising find of 1969 has been the discovery of flourishing colonies of the alien species *Hygromia limbata* in gardens in the Malvern area of Worcestershire. Mrs. Saul informs me that the snail has been established at Castlemorton at least since 1965.

Monacha cantiana at Cromford, Derbyshire, represents a noteworthy extension of known range.

Several important discoveries in Wales are due to Mr. S. P. Dance. First comes the find of *Menetus dilatatus* at Llyn Trawsfynydd, Merioneth. The waters of the lake receive heated effluent from a local power station, raising the suspicion that the colony is an accidental introduction now maintained under somewhat artificial conditions (*Nature in Wales*, **12** : 10). Outstanding also is the discovery of *Pisidium lilljeborgi* in and by the River Teifi in Carmarthen and Cardigan. Not only do these sites represent a noteworthy extension of range, but show the species living under unusual conditions; normally *P. lillpeborgi* likes the clean sandy bottoms of mountain lakes, but in these new Welsh localities it was collected in silty mud below flowing water (*J. Conch.* **27** : 177). Other interesting Welsh records of rarities are of *Vitrina major* and *Limax tenellus* in woods in Glamorgan.

In Scotland *Agriolimax agrestis* has been found in Kirkcudbright and Westerness. It will probably turn out to be fairly common in Scotland, where it has been overlooked owing to confusion with the ubiquitous *Agriolimax reticulatus*. Nevertheless, with experience it can readily be separated from that species on external criteria alone (*J. Conch.* **27** : 109).

The outstanding find in Ireland is the verification by Mrs. J. A. Paton of an unconfirmed record of the 1860's of *Marpessa laminata* at Lough Gill, Co. Sligo (*Ir. Nat.* 2 (1893) : 301). This is the extreme limit of the species in north-west Europe. Also of interest is the find of a dead shell of *Ena obscura* near Malin, Donegal. Further search should be made for living material, as the species is rare in the northern part of Ireland.

M. P. Kerney,
Non-Marine Recorder

RECORDER'S REPORT : MARINE MOLLUSCA

The flow of records has been maintained in a very satisfactory manner at a slightly increased level to that reported last February.

Publicity. Flt. Lt. D. A. J. Taylor who joined the Society in 1968 acts as Publicity Member for the R.A.F. Sub-Aqua Clubs. His first News-sheet, circulated to all branches, and produced in 1969, had a marked conchological bias and included basic information on the Marine Census together with a copy of the prototype recording form. Accounts of the work associated with both the marine and non-marine Censuses was included in Vol. 2 of *School Projects in Natural History* published by the Devon Naturalists' Trust in January 1969.

Review of the Marine Census Areas. The following notes indicate those members who have submitted lists and, where necessary, specimens for verification or as Voucher material from Areas since February 1969.

C.A.1, Shetland : Mrs. N. F. McMillan.
C.A.2, Sutherland : Mrs. E. B. Rands and family.
C.A.3, Orkney : Mrs. McCrae (per Mrs. A. M. Brockbank); Mrs. E. B. Rands and family.
C.A.5, Moray Firth : D. W. McKay; Mrs. E. B. Rands and family; A. Skene and family; Dr. Shelagh Smith.
C.A.6, Aberdeen : D. W. McKay.
C.A.7, Firth of Forth : Dr. Shelagh Smith (plus Voucher specimens).
C.A.8, North Sea : D. W. McKay (collection from deck of fishing vessel).
C.A.9, Northumberland : Dr. Shelagh Smith (plus Voucher specimens).
C.A.11, Yorkshire : Mr. and Mrs. John Llewellyn Jones.
C.A.14, E. Channel : Mrs. E. B, Rands and family. A Field Meeting will be held at Camber on 15 March 1970.
C.A.15, Wight : Dr. B. S. Moreton; Mrs. E. B. Rands and family; Dr. P. J. C. Russell.
C.A.16, Portland : G. W. Pitchford. Some records resulted from a Joint Field Day held by the Croydon Branch of British Sub-Aqua Clubs (led by Gilbert Dinesen)

and members of the Conchological Society (led by John Llewellyn Jones). Details of this outing are in *Conchologists' Newsletter* No. 31. A further joint excursion by these groups is planned 20–21 June 1970 at Swanage, Dorset.

C.A.18, West Channel : Mrs. E. B. Rands and family.

C.A.19, Scilly Isles : D. A. J. Taylor; Mr. and Mrs. John Llewellyn Jones.

C.A.20, N. Cornwall : Mrs. J. C. and Miss A. G. Charlish; Mrs. E. B. Rands and family.

C.A.21, Bristol Channel : D. A. J. Taylor (plus Voucher specimens).

C.A.22, Cardigan Bay : Mrs. A. M. Brockbank; Mrs. J. C. and Miss A. G. Charlish; Mrs. H. H. J. Nash. There is to be a Field Meeting in the Area from 3 to 5 April 1970 and it is hoped that any records will be submitted in time to be included in the compilation of species planned for the June issue of the *Conchologists' Newletter.*

C.A.23, Anglesey: D. A. J. Taylor (plus Voucher specimens).

C.A.24, Liverpool Bay : P. Cambridge. A list for this Area was published in *Conchologists' Newsletter* No. 29. A special list resulting from three Field Meetings has also been compiled (by members) for Southport alone (see *Conchologists' Newsletter* No. 21, 25 and 30) and a fourth Field Day is planned for the 19 April during the special Northern Meeting of the Society.

C.A.25, Solway : G. W. Pitchford.

C.A.26, Isle of Man : Mrs. E. B. Rands and family; Mark Walker.

C.A.29, Clyde and Argyll : D. Heppell; Mrs. E. B. Rands and family.

C.A.30, Minch : Dr. Larch Garrad; A. Skene, Snr., and A. Skene, Jnr.; Dr. Shelagh Smith (plus Voucher specimens); Richard Preece and Martin Willing. The last two are Junior Members who took advantage of a day on a scallop dredge in the Minch whilst holidaying in Skye; they were allowed to take any specimens except *Pecten maximus,* and their haul consisted of 80 specimens, many of them taken alive and some being new to the list so far compiled for the Area. Their finds included such rare Northern species as G.1 *Scissurella crispata* Fleming, G.15 *Lepeta fulva* (Müller) and G.188 *Trophon barvicenis* (Johnston).

C.A.33, N. Donegal : Mrs. A. M. Brockbank.

C.A.35, Mayo : Mrs. A. M. Brockbank.

C.A.37, Fastnet : Mrs. A. M. Brockbank.

C.A.38, Cork : Mrs. A. M. Brockbank.

Some Selected Records. Until lists of species have been compiled for the various Census Areas taking further account of those from past publications and museums, it is not realistic to indicate "new" records in the Annual Report. Where such have been designated to collectors this means, in effect, new to the Society's files. An exception can of course be made for those Areas for which there are recently published lists or if the range of a species is found to be wider than that indicated in modern reference books.

G.126 *Chrysallida indistincta* (Montagu)

C.A.21, Bristol Channel : One "B" specimen found in the Dale Fort district at 60′ in Jack's Sound, October 1969 (D. A. J. Taylor). This species is apparently new to the Area and new to the "Dale Fort marine Fauna" (*Field Studies* Suppl. to Vol. 2, 1966).

G.157 *Turbonilla elegantissima* (Montagu)

C.A.21, Bristol Channel : One "B" specimen found in the Dale Fort district at 60′ in Jack's Sound, October 1969 (D. A. J. Taylor). A new record for the "Dale Fort marine Fauna" (*loc. cit.*) although already listed for the Area.

L.7 *Nuculana minuta* (Müller)

C.A.23, Anglesey : One "A" specimen at 40′ off north coast of Holyhead, November 1969 (D. A. J. Taylor). This species seems to be rare in southern Britain although there are a few scattered records for the Bristol Channel and the eastern end of the English Channel.

L.135 *Pharus legumen* (L.)

C.A.25, Solway : There are numerous "B" records of this species noted by Miss M. Garnet and Mr. G. W. Pitchford in "Marine Mollusca of Lakeland" (Garnet, M., and Milne, M. M., 1967 *Trans. Carlisle Nat. Hist. Soc.* 2 : 30). Mr. Pitchford has submitted records of five "A" specimens found at low spring tides from 1950–1957 between Haverigg and Silecroft.

C.A.26, Isle of Man : One "B" specimen from Fleet Bay, Kirkcudbright, August 1969 (Mrs. E. B. Rands and family). Several "B" specimens in Fleet Bay, Kirkcudbright in the Summers of 1965, 1966 and 1967 (Mark Walker).

C.A.29, Clyde and Argyll : One "B" record for 1957 and a few "B" records for the last century are listed in Allen, J. A., 1962 *Fauna of the Clyde Sea Area*, p. 69 (published by the Scottish Marine Biological Association).

The fore-going records show that like so many "southern" species, *Pharus legumen* maintains populations throughout most of the British west coast, although these become progressively fewer in a northerly direction. In this instance the species has a distinctly more marked north-west range than indicated by McMillan, N. F., 1968 *British Shells*, p. 94, and Tebble, N., 1966 *British bivalve seashells*, p. 160.

L.159 *Zirfaea crispata* (L.)

C.A.29, Clyde and Argyll : Two "A" specimens in stiff clay, Balloch Bay, Isle of Great Cumbrae, May 1965 (D. Heppell). Although there are many 19th century records for the species in the Area (see Allen, J. A., 1962 : 72, loc. cit.) this seems to be the only recent one.

Specialist Research. The Census files have been used to supply information in the following instances during the past year. Dr. J. Bowden (records of venerids for his monograph on British bivalves). Mr. C. Boyden (working on *Cerastoderma edule* (L.) and *C. glaucum* (Poiret) (see *Conchologists' Newsletter* No. 29). Mr. B. Davis (for research on the genus *Dentalium*). Dr. B. S. Moreton (concerned with ecological factors relating to the shipworms L.167 *Lyrodus pedicellatus* (Quatrefages) and L.168 *Teredo navalis* (L.). Dr. P. J. C. Russell (for research on the taxonomy and ecology of L.92 *Parvicardium exiguum* (Gmelin) : see *Conchologists' Newsletter* No. 31). Dr. Shelagh Smith (working on the relationships of G.73 *Rissoa lilacina* Récluz, *R. rufilabrum* (Leach), *R. violacea* Desmarest and *R. porifera* Lovén, all of which are considered to be separate species by Nordsieck, F., 1968 *Die europäischen Meeres-Gehäuseschnecken* : in this instance it was possible to inform Dr. Smith of collectors with specimens available for examination). A request for opisthobranch records has been received from Dr. T. E. Thompson who is preparing a monograph on the group, but before any are sent an attempt is being made to obtain more information in the files : any records, with specimens whenever possible, will be very welcome.

Identification of Specimens. Quite apart from the checking of species new to an Area, for which the Recorder must continue to take prime responsibility, there is an avowed need for help with identification especially of the smaller gastropods and the opisthobranchs. Although not within the terms of reference for recording, from which in fact it does filch much time, it is obviously an important service since there are many people who, with some assistance, soon gain confidence and an expertise of their own. Offers from one or two very capable and experienced members prepared to help others in this way have already been accepted; would anyone else ready to help please let the Recorder know.

The Recorder is very grateful to Mrs. E. B. Rands who makes copies of the various Area lists as these are prepared, so that a copy of each will eventually be available for loaning, and to all those who have spent time and trouble listing and submitting records and specimens. Thanks are also due to Dr. V. Fretter and Dr. T. E. Thompson for identifying and checking material, and to the three members of the Marine Census Sub-committee, Mrs. N. F. McMillan, Mr. D. Heppell and Mr. L. W. Stratton for various help. Special thanks are owed to Mr. Stratton for once more presenting this Report.

STELLA M. TURK

REPORT ON JUNIOR MEMBERSHIP, 1969–1970

Membership. During the year 13 new members have been elected, 7 have been transferred to full membership, 3 have been removed from the active list for differing reasons, this leaves a present total of 34.

Papers for Students. (a) *New publications.* (1) No. 11, "Collecting British Marine Molluscs" (S. M. Turk), 16 pages, 4s. 6d., 18 January 1969. (2) No. 12, "Key to British Slugs" (A. E. Ellis), 12 pages, 3s. 6d., 1 August 1969.

(b) *Reprints.* (1) No. 8, "Dissecting Snails", 1 March 1969. (2) No. 7, "Literature on British Molluscs", with two pages of additions and corrections, 24 April 1969. (3) No. 3, "Key to the Land Shells of Britain", 1 January 1970. (4) No. 10, "The Care of a Collection", 2 February 1970.

(c) *Sales.* The proceeds of sales during the year amounted to £57 9s. 9d. compared with £10 1s. 0d. in the previous year.

Publicity. Reviews, or a short mention, of *Papers for Students* have appeared in *School Science Review*, *Education in Science*, *Natural Science in Schools* and *Habitat.* The first mentioned ran into 239 words referring to Nos. 10 and 11. Mention was made of the Society and Junior Membership in Mr. Stratton's work *Your Book of Shell Collecting* and Mrs. McMillan's *British Shells* both of which brought in a number of enquiries and several of these became Junior Members. An experiment in publicity by circularising secretaries of the local Natural History Societies with copies of the green leaflet has brought in requests for *Papers for Students*, membership, and one request for a lecture.

H. E. J. BIGGS

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J. Conch. **27**: 291–348 (1972)

THE ZOOGEOGRAPHY OF THE NON-MARINE MOLLUSCA OF EAST AFRICA

Bernard Verdcourt

Spring Cottage, Kimbers Lane, Maidenhead, Berks.

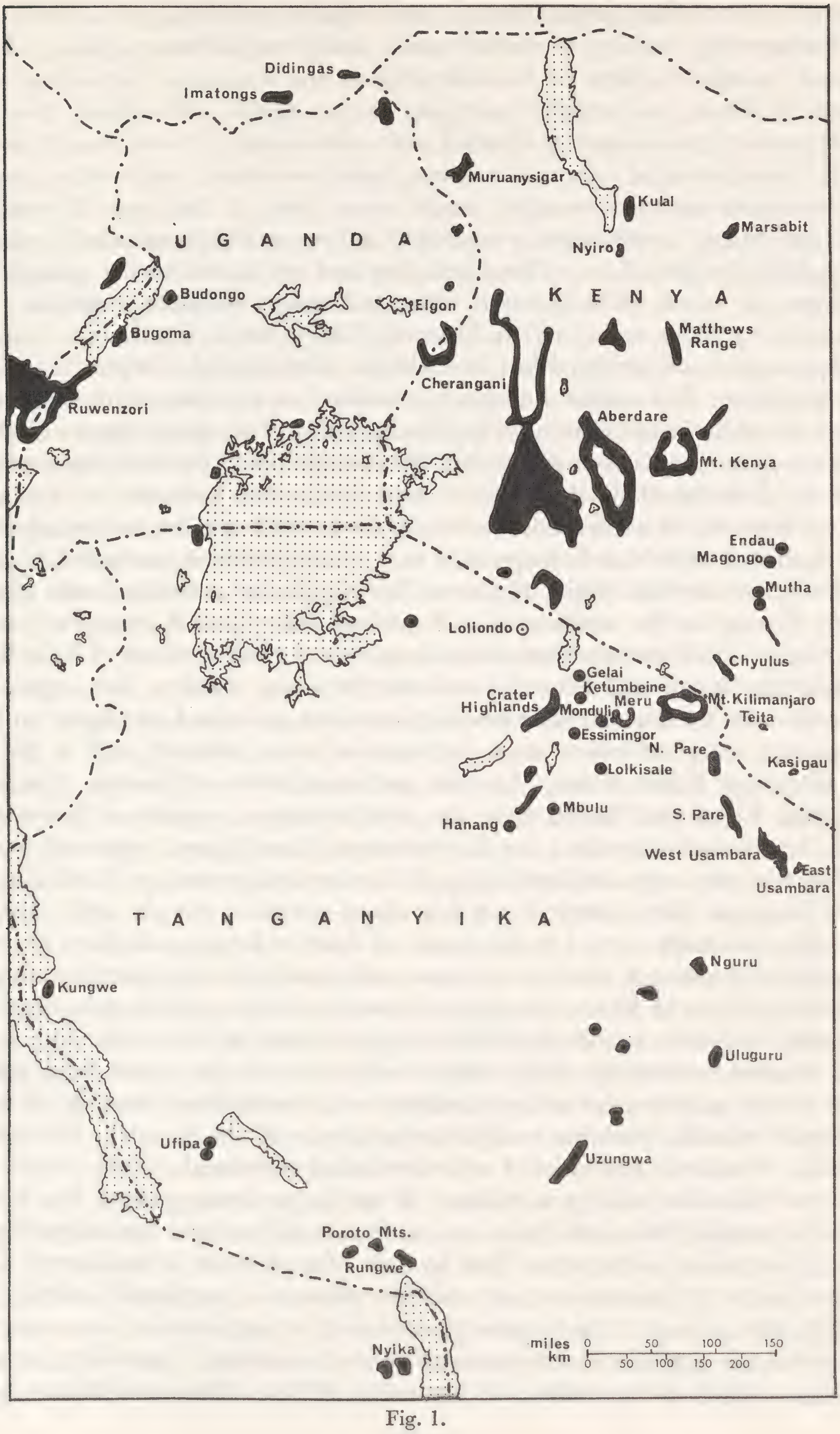
(*Presidential Address delivered 15 February 1969*)

Having spent some 15 years in tropical East Africa it is perhaps natural that I should talk to you today about that part of the globe. There are two ways of approaching museum work—one is to treat the material regionally and the other to treat it systematically. The latter method is usually considered to be the more scientific—to monograph a genus or family throughout its range and attempt to evaluate the phylogeny of the species concerned, as compared with a survey of the fauna of a given area. It is, however, unusual for the person making the study to have a first hand knowledge of more than a small area of the planet. It is perhaps realistic then to suggest that local studies based on personal knowledge are not without value. Matthew Connolly gave a presidential address to the Society in October 1930 on the Mollusca of the whole African continent and I do not think the subject has been touched on since then at any meeting of this Society.

East Africa is straddled across the equator with a coast line bordering the Indian Ocean and a western boundary formed by the lake region of the Western Rift. In days of British rule the territory was a single unit but the component countries, Kenya, Uganda and Tanzania are now but loosely federated. The total area including the offshore islands is approximately 682,800 square miles, of which 38,860 square miles are occupied by inland waters, including several very large lakes. There is almost unlimited variation of habitat from the mangrove swamps at sea level to the mountain tops, which include Kilimanjaro (19,340 ft.), Kenya (17,058 ft.), Ruwenzori (16,794 ft.), Meru (14,979 ft.), Elgon (14,176 ft.) and the Aberdares (13,214 ft.); some of these rise above the vegetation limit but Elgon and the Aberdares are too low to carry permanent snow. In the Western Rift lies the second deepest lake in the world, Lake Tanganyika, 450 miles long and having a maximum depth of nearly a mile (4,706 ft.); in addition this Rift contains Lakes Albert, Edward, George, Rukwa and Nyasa, but only a small part of the latter comes within our area and is usually excluded. Behind the coastal belts there is, at least in the north, a waterless steppe 10–40 miles wide, sometimes called the Taru Desert in Kenya, and interrupted by small hills and a few mountains; this steppe acted as a powerful barrier to the earliest visitors from overseas, but now takes scarcely an hour to cross by car; the familiar (at least on old labels) terms Masai Steppe and Nyika also refer to this area, but are seldom used today. Further inland there is an extensive peneplain dating from towards the end of the Tertiary which ranges from 800–3,500 ft. above sea level. A map of East Africa showing the areas of montane evergreen forest is given in Fig. 1. In the north-east of Kenya the steppe passes into arid scrub and desert country and in south-east Tanzania into an elevated and dissected plateau. Further west again lie hills and mountains of Basement System and volcanic rocks rising to over 7,000 ft. Between the eastern and western arms of the Great Rift Valley a belt of country almost 300 miles wide and averaging nearly 4,000 ft. in altitude, mostly overlying Precambrian rocks, comprises most of Uganda and the Central Plateau of Tanzania. The Cherangani and Suk mountains lie on the eastern margin and rise to over 10,000 ft., and in addition, there is a chain of major volcanoes. The Ruwenzori Massif forms part of the western border and to the south-east the Central Plateau is flanked by the highlands that lie between Kilosa and the Rungwe volcanic region. Lake Victoria, covering an area of 26,000 square miles, and nowhere exceeding 300 ft. in depth, forms a shallow basin occupying a depression between the two branches of the Rift Valley. The Eastern Rift Valley is a depression about 40–50 miles wide and several thousand feet deep; in it lie a number of lakes (including several saline ones due to internal drainage within the valley), e.g. Rudolf, Hannington, Nakuru, Magadi, Natron, Manyara and Eyasi. Mostly these are ephemeral in terms of geological time but Rudolf did not dry up during the worst interpluvials and was indeed a main source of the Nile as its essentially nilotic fauna indicates. This rift valley lies within a volcanic zone just to the west of the eastern Basement System hills, a zone of rich soils which includes most of the good farming country surrounding Kenya, Kilimanjaro and Meru, and also in the Crater Highlands. Rivers are not as conspicuous a part of the landscape as in some other tropical areas but include a number which flow into the Indian Ocean, e.g. Athi, Tana, Ruvu, Rufiji and Rovuma; the Malagarasi system which is connected via Lake Tanganyika with the Atlantic; a few which drain into Lake Nyasa and, of course, one of the sources of the River Nile which leaves Lake Victoria.

It is important to give a condensed account of the vegetation—essentially a mosaic of savanna and evergreen forest, which are two distinct biological communities with different faunas and floras that have reached their present development through quite different histories. From fossil evidence it is clear that both habitats were present in pre-Miocene times. Now that the two are mixed together and the forest is rapidly being converted into grassland or thicket, it is easy to forget how different their origin has been. The fact that under optimum conditions evergreen forest will regenerate and cover much of the savanna does not hide the fact that the savanna is old enough to have developed thousands of specialised plants and animals which will not live in forest. Conditions in the various types of forest are more uniform and equitable throughout the year but in more open vegetation types the annual changes can be extremely marked. It will probably be more useful for collectors if I describe the three territories separately.

Uganda is placed at the junction of the Sudan–Guinea savannas and the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Mbulu
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S. Pare
West Usambara
East Usambara
T A N G A N Y I K A
Nguru
Kungwe
Uluguru
Ufipa
Uzungwa
Poroto Mts.
Rungwe
Nyika
miles 0 50 100 150
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Fig. 1.

Congo–West African forests. Forests, now forming only 4% of the total cover, are restricted to the higher rainfall areas along the north-west shore of Lake Victoria, on the shoulder of the Rift and on the mountains, several of which exceed 13,000 ft. and exhibit examples of the special Afro-Alpine flora. The major part of the country is covered with cultivations or fire-induced savanna but, in the absence of man and his fires, forest, woodland and thicket, together with extensive seasonal swamps, would cover most of the area. Towards the north the climate becomes much more arid and some of the supported associations are, judging by their flora, of long standing and not due to recent changes.

Kenya, by virtue of its greater altitudinal range, possesses vegetation types additional to those occurring in Uganda. The coast is lined with mangrove swamps, now much depleted but in sheltered inlets and also beyond Lamu, still quite extensive. The coastal bushland, woodland and grassland mosaic occupies a narrow belt and some extremely interesting lowland evergreen forest of both dry and wet types remains in small patches. Between this belt and the upland area over 5,000 ft., and also along the northern part of Kenya's boundary with Uganda, are vast stretches of rather arid country covered with a most interesting Somali type bushland and thicket, frequently very dense, which is composed of several hundred characteristic species of plants. This association is decidedly not of recent origin; further to the north-east and around Lake Rudolf extensive areas of semi-desert occur but true desert is mostly restricted to an area east of Lake Rudolf between Mt. Kulal and Marsabit and the Ethiopian border. The higher parts of the country are covered with wooded grassland, grassland and forest and pure grassland mosaic, but forests are to be found on many isolated peaks in the more arid areas, e.g. Kulal, Nyiro, Marsabit and many hills in Ukamba. The higher mountains Elgon and Kenya have the usual zoning of vegetation, forest giving rise to heath and above that the characteristic Afro-Alpine formation. Swamps are few, the only extensive ones being the Lorian and several in North Turkana.

In Tanzania the coastal forest–woodland–savanna mosaic and mangrove formations naturally form a continuation of those of Kenya and there are extensive areas of bushland, thicket, savanna and grassland, also directly continuous with similar types in Kenya; there are, however, in the central area, notably at Itigi, some characteristic thickets not related to those in the north. The general effect is more broken up and patchy compared with the rather bold patterns found in Kenya. Extensive areas coinciding with those where there is one season of summer rainfall, perhaps nearly three-quarters of the country, in west and south-east Tanzania are covered with deciduous woodland, mostly of the type known as 'miombo', chiefly a mixture of two Leguminous genera *Brachystegia* and *Julbernardia*. This is swept by annual fires and numerous fire-adapted plants (pyrophytes) occur in this type. The amount of true forest is small; only 2–3% of the country is covered with it and the amount is continually diminishing, although the amount of land under planted trees is kept more or less constant to conserve water supplies. Forest remnants occur in a rough U stretching from the north-east corner of the territory to just north of Lake Nyasa and thence up the side of Lake Tanganyika, forming part of a previous migration route for forest animals. Lowland and Upland Rain Forest occurs in an arc on the east side of the U, particularly on the Usambara, Nguru and Uluguru Mountains and also in parts of Ulanga and Iringa districts; this type of forest has much in common with the Guinean and Congo forests. Lowland Evergreen Forest, once extensive in the coastal areas, is now represented by scattered fragments, and Upland Evergreen forest occurs in drier parts of many of the more prominent mountains, e.g. West Usambaras, Pares, north Kilimanjaro, east Meru, Crater Highlands and Hanang, as well as in the south on the Poroto and Livingstone Mountains. Much land previously under forest even in historical times is now covered with cultivation or, at best, forest–grassland mosaics. On Kilimanjaro and Meru the characteristic Afro-Alpine flora is found. Freshwater papyrus swamps are found extensively round the lakes and also along rivers, notably along the Malagarasi; grassland swamps occur in the Wembere, Rukwa, Usangu and other depressions. This exceedingly sketchy account of the vegetation will at any rate dispel the frequently held illusion that East Africa is covered with steaming jungles and impenetrable forest. Dense primaeval rain forest is distressingly hard to find.

The distribution of the vegetation is of course linked to several factors, notably soil and climate, and a few words are necessary, particularly as every collector knows that soil is a major factor determining whether a locality is "good for snails" or not. Much of the soil is acid sandy loam or slightly alkaline red earths, loams and clays, scarcely favourable for molluscs, but limestone formations do occur, although Cretaceous and Jurassic deposits are only found near the coast. Rainfall in East Africa is much more erratic than in the temperate regions and stations are known where the maximum annual figure is 400% higher than the minimum. The actual amount of rain is not so important as when it falls. Over two-thirds of the country has a completely dry six months, and only 20% has any appreciable rain every month; 35% of East Africa gets less than 20 in. a year and 4% over 50 in. Large areas of Kenya receive less than 5–10 in. but on the other hand a fall of 15 in. in one day has been recorded on the coast. Roughly speaking the rainfall of the coast area is 40 in. a year (although about 60–80 in. is needed to support the lowland evergreen forests) dropping to 10–30 in. in the drier areas behind, then rising to 40–60 in. in the highland areas, the rainfall increasing with altitude until montane forest changes to heath at 7,000–10,000 ft. Beyond the highland areas rainfall usually decreases due mostly to rain shadow effects caused by elevated and tilted blocks of land. Annual totals have varied from 4·45 in. for a semi-desert area to 130 in. in a forest area. The rain falls in one or two periods according to the influences at work in the area concerned, e.g. trade winds, S.E. monsoon, etc., and the actual pattern over the whole territory is very complicated. From Zanzibar through the Kenya Highlands to Somaliland there are two well defined rainy seasons per year. Mean temperatures vary from under 0° (F.) on the mountain tops to 76° (min.) and 93° (max.) on the coast, and there is but little monthly variation; the actual temperature rarely rises above 100° (although 105° has been recorded at Magadi in Kenya) and the actual soil surface temperature in desert areas can reach 150°.

It is not, of course, possible to consider East Africa on its own and some account of its relations with the rest of Africa are necessary. To the north-east the arid country is merely an extension of the arid Somali wedge which may possibly have continued south to South-West Africa in the past, forming an arid corridor. To the north, although separated by an arid area, the Ethiopian highlands have much in common with the Kenya highlands. To the north-west the Uganda savanna passes into the Sudanese and West African savanna, and to the west the Uganda forests pass into those of the Congo and West Africa. The "miombo" woodland of the west and south-west is only a small outlier of the vast Central African woodland of this type and the coastal formations extend down as far as Natal.

Some knowledge of the past history of the country is also desirable. One certain fact concerning the early history of Africa is that most of it has not been submerged under the sea since before the Cretaceous; it is in fact a mass of Palaeozoic rock whose outlines have been preserved little altered, less so in fact than most other parts of the globe. The supporters of the Drift Theory (as against those who favour land bridges) consider that during the Carboniferous, Africa formed part of the southern continent of Gondwanaland together with parts of America, India, Australia, etc. separated from the northern continent by the Tethys Sea; today the only fragment remaining of the latter forms the Mediterranean. Africa and part of South America started their drift away from Gondwanaland in the Upper Permian and by the Jurassic were in contact with the Algero-Maroccan province of Atlantica. Early in the Cretaceous, South America and Africa parted and by the mid-Cretaceous Africa had pivoted round to form the Mediterranean, and India was drifting north to join a northern block. This admittedly controversial theory is mentioned to add interest to later considerations of the broad affinities of the African Mollusca. During the past 2×10^7 years there have been connections between East Africa and Arabia and Tunis with Sicily, but never any connection across to Gibraltar. Moreau states that recent geological opinion rejects the idea of any connection between Africa and Madagascar at any time relevant to the evolution of birds, but in the past it was thought that there might have been links at the beginning of the Tertiary. Certainly there are hundreds of plant genera and many species common to the two areas whose distribution is difficult to reconcile with this. Zanzibar was joined to the mainland until 16,000 years ago but became separated owing to a rise in sea level. A eustatic fall in sea level of more than 100 m. at the height of the glaciations would have widened the coastal regions, but the extent would be governed by the very narrow continental shelf. After isolation, continuous erosion of uplifted masses of rocks occurred until the Miocene, producing a great peneplain 2,000–5,000 ft. above sea level, a feature that is still obvious over much of the continent today; in fact there are traces preserved of previous major peneplains dating back to the late Jurassic. Certain Basement Complex based areas such as Ruwanda,

?* Ruwenzori Mountains, Usambara Mountains and Uluguru Mountains are remnants of masses of hard Palaeozoic rocks uplifted in the Jurassic and almost certainly remained as relicts above the Miocene peneplain. Thus they are due to erosion and not to recent upthrust but were tilted in the Pliocene. During the Miocene (12×10^6) vast areas of East and South Africa were lifted 4,000 ft. and Ethiopia and the Kenya highlands were overlaid with large areas of volcanic lava. During the Pliocene the volcanoes Kilimanjaro and Mt. Kenya began to build up and, before the end of that epoch, Elgon and Cameroon Mountains†. Within only the last three-quarters of a million years in the Pleistocene the changes have been spectacular. The Great Rift Valley appeared in its final form, the Kenya highlands and other major mountains finished their build up, completely new mountains such as Rungwe, Marsabit and Kulal appeared, and the Pliocene Congo lake drained and was replaced by forest. Certain "mountains" such as the Chyulu Hills and Nyambeni Hills are very recent in origin (40,000 years BP) but nevertheless are covered with evergreen forest of complex structure. As is well known, during the Pleistocene there were at least four major glaciations in the northern hemisphere and attempts have been made to correlate these with pluvial and interpluvial periods during which first the forest elements and then the savanna elements of the forest–savanna mosaic would have dominated. This expansion and contraction of the two elements owing to climatic variation played a large part in deciding existing distributions and two very interesting maps have been prepared by R. Carcasson (1964) showing the vegetation at the wettest and driest periods based on the present day distribution of butterflies. Of course all conclusions derived from plants, birds, insects and other groups do not necessarily fit in with those derived from molluscs unless allowances are made for the totally different methods of dispersal involved. In the interpluvials the forest retreated to 6,300 ft. (1,900 m.) during which time the montane habitats would have been very separated and, indeed, eliminated from many areas; at the height of the pluvials the montane habitats would have occupied land down to 1,660–2,330 ft. (500–700 m.) (calculated from estimated temperature drops of about 5°C.). Vast areas from Ethiopia to the Cape with an extension to the Cameroons, would have been a continuous block of montane vegetation, and lowland habitats would have been compressed to the coastal rim and widest in the north Kenya–Somali area where it might have been 200 miles wide. At present "lowland habitats" merge into "montane habitats" at about 5,000 ft. (1,500 m.) (equivalent to a mean annual temperature of 18°C.) and to "alpine habitats" at about 10,000 ft. (3,000 m.). When considering the present day distribution of forest it is important to realise that its pattern has changed very considerably in under two hundred years due to man, and many forest patches now appearing quite isolated were linked by unbroken forest. Man's activities started to have effect as long ago as 50,000 BP. Much has now been published on Pleistocene climatic changes and those interested can study the papers referred to in the bibliography, all of which contain extensive further references. Roughly speaking it is now accepted that 150 years BP was 1–2° cooler than now, 5–7,000 years BP 2–3° warmer, and 20,000–50,000 years BP, at the height of the last glaciation, 4–6° colder. Oscillations from cold to hot are not smooth but disturbed by subsidiary ripples. Inexplicable problems, however, remain, of which the following is an example. On all the highest East African mountains there exists a strange Afro-Alpine flora comprised of Giant Lobelias, Giant Senecios and other specialised plants. The species of the several genera are mostly vicariants and clearly derived from common ancestors, the results being those which would be expected if all the mountain-top floras had been in contact at a post-Pliocene date—it has to be recent since the mountains concerned are not old and the species are clearly closely related. The drop in temperature needed to put these floras in contact would have destroyed most of the other forest communities completely and certainly not permitted the undoubtedly ancient arid Somali wedge to have its present form. At the coldest time the glaciers were 3,330–8,330 ft. (1,000–2,500 m.) lower than now—quite inadequate for direct contact. The alternative of long distance dispersal of whole floras comprising numerous genera and species seems equally unrealistic even though facilitated by extreme cold.

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*Recent evidence suggests it may be no older than Mt. Kenya, $2{\cdot}7 \times 10^6$ years.

†The Ethiopian Highlands, Aberdares and Cherangani Hills have recently been estimated at $10–15 \times 10^6$.

The earliest written record of East Africa is in the "Periplus of the Erythraean Sea" of the 1st century AD, but the series of ports it mentions have not been identified, though Rhapta may have been in the Pangani estuary. Various famous Arab writers such as Ibn Battuta, who was in Kilwa in 1332, have mentioned the coast. The East African coast was known to the Arabs over two thousand years ago; they set up numerous settlements, and trade with other nations even as far away as China was commonplace by the 10th century. Europeans first visited the coast in 1495. Ibn Majid, the Arab pilot who showed Vasco da Gama the route from Malindi to Calicut in 1497, made it clear that Portuguese ships had already been to Malindi. By 1506 a fortress had been built at Kilwa and Fort Jesus in Mombasa was established by 1593. The now famous seaside resort of Malindi was already an important call for Portuguese ships by the early 16th century and, later, Dutch ships also made their appearance. There was much strife between Arabs and Portuguese but it is unlikely that no natural history objects found their way back to Portugal. It is at present believed that no plants were collected in East Africa until J. de Loureiro collected a few on his way back from Indochina in 1781–2 and presumably no molluscs until a good deal later. East Africa was missed by European travellers who either went through Egypt and Syria to the East, or rounded the Cape and pressed on to India and beyond. In any case the Arabs drove out the Portuguese in 1698 and remained more or less hostile to Europeans until the mid-19th century. Even as late as this we still do not know who collected the first specimens from East Africa. *Achatina reticulata* Pfr. was described from the Cuming collection in 1845 but I do not know if Cuming actually visited Zanzibar himself. Strangely enough among the first shells to be collected, by Burton and Speke, were a few picked up on the shores of Lake Tanganyika, members of the most specialised and atypical fauna existing in East Africa. After 1850, Africa was literally invaded by explorers, missionaries, government officials, military men and ordinary travellers. A large percentage of these had it impressed upon them that collections were worth making and by the end of the 19th century most of the striking East African shells had been described, mostly by such famous workers as E. A. Smith, E. von Martens, J. R. Bourguignat and others. The culmination of this era was the great work of von Martens, *Beschalte Weichthiere Deutsch-Ost-Afrikas* (1897), still the only work on the molluscs of the area and a foundation for all future work. He lists some forty collectors of various nationalities,* only two of whom were also conchologists, and described their own findings. Since the turn of the century, very many collectors have added to our knowledge and a list of them would be difficult to compile. These collections were worked up by a number of conchologists, notably (or perhaps notoriously would be a better word in the case of the second mentioned) M. Connolly and H. B. Preston, but many others have added to our knowledge. Despite this activity a great deal needs to be done and little is known about the true relationships of many East African molluscs. Some workers have described numerous species in very difficult genera from the shell alone and it is not possible to name new material with certainty even with the types before one. Preston, for example, described numerous *Thapsia* "species", many from worn or immature (or both) specimens. These all look very alike and it is not at present possible to say whether there is one species or thirty. Until each one has been collected in the type locality and dissected no progress is likely to be made. Many of the type localities are now almost inaccessible, the specimens having been collected in the long past days of large safaris with porters. Under these circumstances, the production of a check list which would be anything but a list of names would be practically impossible. During the past fifteen years I have maintained a manuscript list and the meat of this paper is derived from it. In the table I have attempted to list all the genera of land and freshwater mollusca known from East Africa with some account of the number of species involved and their distribution. Zoogeography must essentially be based on sound taxonomy—it is useless drawing conclusions from a supposed occurrence of a genus in two separate areas when adequate anatomical examination shows that two quite unrelated taxa have been confused. I have therefore given an indication of the value of the taxon for zoogeographical purposes. "Good" in this column means that the East African species do belong close to the type of the genus concerned. "Poor" conversely means that further examination may well show they are not referred correctly to the genus in which they are currently placed. The number of species varies in accuracy from genus to genus according to the revisional work which has been done; undescribed species have often been added. Where the number is believed to be exaggerated this fact is noted in the column on Remarks.

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*Some of these were discussed in my second Presidential Address.

We must now see what conclusions, if any, can be drawn from this mass of data covering some 156 genera and over 1,200 species. Of the terrestrial species the majority are forest dwellers and the vast areas of desert, bushland, woodland subject to seasonal burning, and alpine "moorlands" are very poor in molluscs. This is, of course, a well known fact in other parts of the world and dictated by the physiology of the beasts. Few species have successfully adapted themselves to seasonally harsh conditions but they are frequently quite abundant. The table can be broken down ecologically as follows:

Evergreen Forest	844	
Bushland, thicket & arid areas	156	
Alpine zone (above 10,000 ft.) (terrestrial)	15	
Freshwater	193	(inc. 3 alpine)
Brackish Water (mangrove swamps, above high tide on cliffs, etc.)	24	
	1232	

In the above table it has not always been possible to account accurately for the habits of every species owing to lack of information or an overlap in the ecological preferences; in some cases therefore, where a genus occurs in both, the total number of species has been halved, e.g. in *Edouardia*, of the 18 species, 9 have been accepted as living in bushland and 9 in evergreen forest. This may seem a very inaccurate way of estimating but in some cases it is all I have been able to do and it will provide a first approximation. The most likely error is that the forest element has been exaggerated.

A break-down from the systematic point of view is illustrated in Fig. 2 which will enable comparison to be made with the figures given by Solem in his masterly account of New Hebridean snails. Summarising the figure the various groups are represented numerically on page 301. I have used the grouping Heterurethra although Dr. Rigby has recently claimed that the Succineidae are terrestrial opisthobranchs. Since this is unlikely to be acceptable without further study I have retained the older concept.

Introduced molluscs are not common in East Africa. Boettger (1956) records five introduced species from Tanzania, amazingly all found by H. Knipper in almost or quite wild habitats, namely *Abida frumentum* (Drap.) (Uluguru Mountains), *Papillifera bidens* (L.) (Kigoma), *Leucostigma leucostigma* (Rossmässler) (Kigoma), *Xeropicta gyroides* (Pfeiffer) (Chimala), *Murella fuscolabiata* (Rossmässler) (Uluguru Mountains and Kigoma). None of these has been found before or since. I have recorded *Zonitoides arboreus* (Say) and *Agriolimax laevis* (Müll.) from Nairobi and *Lamellaxis gracilis* (Hutton) is not uncommon in the coastal areas of Kenya and NE. Tanzania, and had presumably been introduced long ago by trade with India. Numerous *Opeas* described by Connolly from various parts of East Africa seem to be no more than forms of *L. gracilis*. Several other

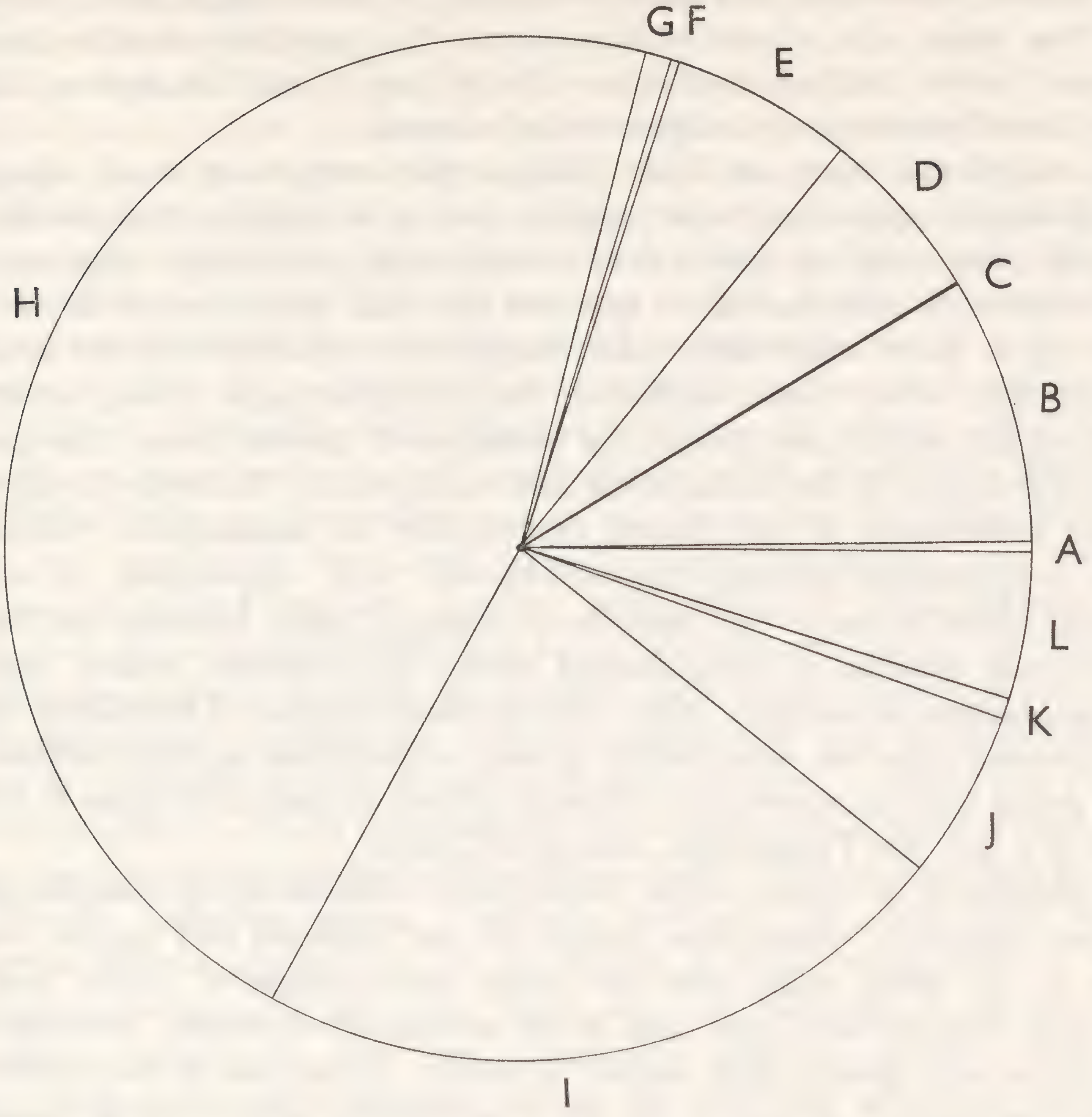

Fig. 2.

Group	Number of Species
Archaeogastropoda (A)*	4
Mesogastropoda (Archaeotaenioglossa) (B)	105
Mesogastropoda (Neogastropoda) (Stenoglossa) (C)	1
Euthyneura (Basommatophora) (D)	69
Euthyneura (Stylommatophora-Orthurethra) (E)	71
Euthyneura (Stylommatophora-Mesurethra) (F)	4
Euthyneura (Stylommatophora-Heterurethra) (G)	11
Euthyneura (Stylommatophora, Sigmurethra, Holopodopes) (H)	567
Euthyneura (Stylommatophora, Sigmurethra, Aulacopoda) (I)	265
Euthyneura (Stylommatophora, Sigmurethra, Holopoda) (J)	68
Euthyneura (Systellomatophora) (=Soleolifera, Veronicellacea) (K)	9
Pelecypoda (L)	58

*These letters refer to Fig. 2.

species already mentioned and usually accepted as native might have been introduced long before the advent of Europeans. The possibility should always be considered before fanciful theories are thought up to explain curious disjunct distributions of single species as against whole faunas.

The exceptional fauna of Lake Tanganyika comprising many species of markedly marine appearance was formerly held to be evidence that the lake was a trapped inland sea, but this is now known to be geologically quite unsound. What is known is that the lake is very old and that because of its depth it did not dry up at times when other lakes disappeared; moreover its bed is crossed by ridges that would have resulted in three separate lakes during severe dry periods, which would have helped the evolution of diverse forms. The peculiar marine appearance of the fauna seems best explained by Hubendick's suggestion that this appearance is the *natural* end-product of unrestricted evolution in aquatic environments and that the well-known "dull" appearance of ordinary freshwater shells is due to the short-lived nature of their habitats and the fact that a certain number of well-adapted species are dispersed widely from one temporary habitat to another—hence also the small number of freshwater species. This is obviously the best evolutionary answer to short-lived aquatic habitats. The smaller group with poor powers of dispersal die out in each lake when it dries up unless it is a lake like Tanganyika, Baical or Ochrid.

The affinities of the fauna can be considered at different levels—family, generic (including subgeneric where these entities are not artificial) and specific. For the purpose of the above main table the family delimitations of Taylor and Sohl (1962) have been followed and used in the analysis given below. Needless to say delimitations vary greatly from author to author. Endemism at the family level is clearly not marked, in fact of the last four families, which can be considered endemic to Africa, two (Achatinidae and Urocyclidae) are often merged with Subulinidae and Helicarionidae respectively, Maizaniidae has usually been included in the Cyclophoridae, and the Syrnolopsidae are a peculiar small group of freshwater gastropods restricted to Lake Tanganyika and, presumably, rapidly evolved relatively recently in this very special locality. These facts could fit in with a drift hypothesis although this demands that the basic families were in existence much longer ago than is usually admitted, or that the timing of drifting is not correct. Some of the purely northern groups would have entered Africa after it had come into contact with the northern continent. One family not occurring in East Africa which is often mentioned with reference to drift is the Acavidae, which has a wide distribution in South Africa, Madagascar, Seychelles, Ceylon, Australia and South America, thus fitting in with the Gondwanaland concept. Other South African families Rhytidae and Endodontidae show marked Australasian affinities but only the latter reaches East Africa. Other families in Africa fit in more with worldwide inter-communication and subsequent widespread extinctions. Proponents of drift theory frequently pick on the peculiar distribution of individual species or genera to support their theory but I feel it is important to compare whole faunas. Some theory may well be upheld by the distributions of certain species but other distributions may equally well be impossible to explain. The purpose of the work done for this address is really to provide a body of facts for the non-marine mollusca which may be of value to others. No list of genera occurring in East Africa has previously been available.

Considering the affinities at generic/subgeneric level there is a surprising lack of taxa genuinely common to East Africa and America, probably only about 1%. On the other hand about 11% are common to East Africa and Asia. Perhaps on purely geographical grounds this would be expected, but if Africa is considered as a whole the proportions would probably not be much altered. Needless to say, at the specific level, affinities with the rest of the world are even more reduced, save in the case of littoral species which mostly have distributions in the Indo-Pacific region similar to most marine species. Only four non-littoral species are world-wide, two land probably both introduced, one freshwater gastropod introduced and one bivalve; eight extend to Asia, thirteen to the Mascarenes, three to the Middle East, two to Europe and one to the Azores. All the others are endemic or occur also in other parts of Africa south of the Sahara. Wider distribution of species is, I think, undoubtedly due to deliberate introduction or extremely efficient means of dispersal coupled in both cases with very great adaptability to enable the newcomer to compete with the established species. No one could deny that species such as *Physa acuta*, *Pisidium casertanum*, *Lamellaxis gracilis*, *Subulina octona*, *Zonitoides arboreus* and *Agriolimax laevis* all qualify as efficient species and no one would think of using them as zoogeographical indicators. On the other hand, the vast majority of species disperse themselves gradually by their own locomotion coupled, perhaps, with severe winds, attachment to other animals, rafting, etc. until they are present throughout the entire area for which their ecology suits them. Climatic changes may enlarge or shrink this area so that it itself gradually moves. It is therefore easily possible to envisage a species moving right across Africa even if the requisite terrain did not stretch all the way across at any one time. All that is necessary is sufficient time for the mollusc to disperse into the newly suited area before the formerly suitable one becomes unsuitable. In general the distribution of molluscs in East Africa is explainable by the great increase in the area of evergreen forests during the pluvial periods—this will also fit in well with the observed affinities with the Congo, West Africa and Natal. Even where continuity was broken by drier country, connections were often available along riverine gallery forest or the distances involved were inadequate to prevent dispersal by indirect means. For instance, the Kulal and Marsabit Forests could never have been in direct contact yet their fauna and that of Mount Nyiro must all have been derived from the same common source as that of the rest of the montane forests. When a more detailed knowledge of the distribution of species is available on a level with that worked out for birds and butterflies it may be possible to actually plot the approximate pathway various components of the fauna took.

Affinities at family level*

Worldwide	24	(including 3 bivalve families, 3 families missing from S. America and 1 rare in the New World)
Pantropical	6	
Old World only	4	(including 1 restricted to warmer regions)
Europe, Africa, Arabia, Indian Ocean Islands and just to India	1	
Mediterranean, Africa and Indopacific	1	
Africa, America and Australia	1	(Bivalve family)
Africa, America, India and Madagascar	1	(Bivalve family)
Africa and Madagascar	1	(now widespread in Asia due to introduction but perhaps formerly restricted to Africa entirely)
Africa only	2	(accepting that Urocyclidae and Helicarionidae are separate families)
East Africa only	1	(Lake Tanganyika)
	42	

*(Families accepted for this purpose following Taylor and Sohl: Neritinidae, Hydrocenidae Cyclophoridae, Maizaniidae, Viviparidae, Ampullariidae, Littorinidae, Pomatiasidae, Bithyniidae, Truncatellidae, Assimineidae, Thiaridae, Syrnolopsidae**, Potamididae, Buccinidae, Ellobiidae, Lymnaeidae, Ancylidae, Planorbidae, Physidae, Vertiginidae, Pupillidae, Chondrinidae, Valloniidae, Enidae, Clausiliidae, Succineidae, Subulinidae, Ferussaciidae, Achatinidae, Streptaxidae, Endodontidae, Vitrinidae, ?Euconulidae, Urocyclidae, Bradybaenidae, Veronicellidae, Unionidae, Mutelidae, Etheriidae, Corbiculidae and Sphaeriidae.)

**Mandahl-Barth includes this in the Thiaridae.

Affinities at Generic/Subgeneric level

Worldwide	18	(incl. 1 bivalve)
Pantropical	3	
Widespread in Old World	3	(incl. 2 bivalves)
Genera with near relationships in Asia (paired genera)	2	
Widespread or rare in eastern Africa and with distinct European affinities or even Palaearctic (and in 4 cases extending to North America)	9	(incl. 1 bivalve)
Widespread or rare in eastern Africa and with distinct Oriental affinities	21	
Widespread in Africa and with distinct affinities with America (including 1 probably introduced, 1 possibly a wrong determination and 1 extending to Madagascar)	4	(incl. 1 bivalve)
Widespread in Africa (mostly eastern side) and extending to Madagascar and the Mascarenes or other islands in the Indian Ocean (including 1 probably introduced and 1 rare in East Africa)	9	(incl. 1 bivalve)
Widespread in Africa (including S. Arabia) but not known elsewhere	16	(incl. 2 bivalves)
Widespread or in two cases rare in eastern Africa and with distinct S. African affinities	9	
Widespread in East Africa and with distinct Congo and/or West African affinities (2 extending to Rhodesia)	19	
Restricted to East Africa and immediately contiguous areas of the surrounding territories e.g. parts of Congo Republic, Sudan Republic, Ethiopia etc.	15	
East Africa extending to North East Africa, S. Arabia (or in 1 case just to India)	7	
Uganda and West Africa only	1	
Predominantly eastern Africa extending to Ethiopia, Somalia and West Africa	3	
East Africa extending to Central Africa (including 1 also extending to West Africa)	7	
Central Africa just reaching into Tanzania	1	
Kenya, Ethiopia, East Congo, St. Helena	1	
Apparently restricted to East Africa (including 18 Gastropod genera and all 5 bivalve genera from L. Tanganyika, part of which is in the Congo Republic)	49	(incl. 5 bivalves)
Total	197	

Affinities at specific level

	LAND	AQUATIC		LITTORAL
		GASTROPOD	BIVALVE	
Worldwide	2	1	1	3
East Africa – North East Africa	22	11	3	1
East Africa – Congo	134	6	4	
East Africa – West Africa	14	2	2	
East Africa – South Africa	17	6		1
Endemic	771	82	36	6
Widespread in Africa	1	8	4	
Widespread in Africa to restricted to East Africa and extending to the Orient	6	2		10
East Africa – Central Africa	30	5	3	
East Africa or widespread in Africa to Mascarenes etc.	6	4	3	3
Doubtful	5	1		
Central Africa – North East Africa	4	2		
East Africa – Middle East		3		
South Africa – East Africa – Europe		1	1	
North East Africa – South Africa	1	1	1	
East Africa and Azores	1			
Central Africa – Congo and East Africa	1			
	1015	135	58	24

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Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Neritina Lam.	Good	3	Rivers in coastal belt	E. African species extend from Somali Republic to Natal, Madagascar & ? Mascarenes. Genus is pan-tropical			
Hydrocena Pfr.	Good	1	Mt. Kenya, 6500–9000 ft. presumably in montane forest	One in S. Africa near sea level. Also Tenerife, Dalmatian Coast, S.&E. Asia & some Pacific Islands	Pleistocene		Not recollected to my knowledge. Animal needed to check genus; Connolly seemed certain it was allied to the S. African species
Afroditropis Bequaert & Clench	Fair	1	Uganda-Congo border	Not known elsewhere		?Link with tropical Asia	Formerly included in *Ditropis* an Indo-Malayan genus but scarcely agrees
Maizania Bgt.	Good	7	Widespread in evergreen forest	Distinct subgenera in S. Tomé & Guinea. Typical *Maizania* in E. Congo, S. Sudan, N. Malawi, Angola & Natal	Miocene (Kavirondo), Post Pliocene (Mombasa)	Relationships not clearly with America or Asia – former reference to *Ostodes* incorrect	*M. wahlbergi* has disjunct distribution in Natal & East African coast. Miocene species are closest to this coastal species

Bellamya Jouss.	Good	2–3	Great Lakes and also rivers in coastal belt	Widespread in tropical Africa also S.&E. Asia	Abundant in Pliocene & Pleistocene Nilotic deposits	Distinct link with tropical Asia	The coastal race *capillata* often considered a species. Some 18 races in Lakes area. Formerly not separated from *Viviparus*
Neothauma E.A. Sm.	Good	1	L. Tanganyika	One other species in L. Nyasa	Pleistocene (Kazinga, L. Edward & E. Congo)		*N. dubium* is known from quaternary deposits at L. Rukwa, lower Ruzizi and Usambura
Lanistes de Montfort § Lanistes	Good	1	Uganda: rivers and swamps. Kenya: rivers and swamps in north	E. African species also in Egypt, Sudan, Somali Republic	Widespread in Pleistocene Nilotic deposits, Miocene (Kavirondo)		*L. carinatus* has existed unchanged since the Miocene
§ Meladomus Swainson	Good	3–8	Widespread but not in highlands	Widespread in tropical Africa; Madagascar	Subrecent deposits		Synonymy poorly understood. One further species in L. Nyasa
§ Nyassana Bgt.	Good	1	L. Nyasa	Endemic in L. Nyasa			
§ Leroya Grandid.	Good	3	Tanzania	Congo Republic			
Ampullaria Lam.	Good	5	Great Lakes and mainly coastal rivers and swamps	Widespread in tropical Africa; also in S. Asia	Widespread in Pleistocene Nilotic deposits, Miocene (Kavirondo)		Species are rather dubious. Great Lakes species has about 5 races. *A. ovata* has existed unchanged since the Miocene

GENUS OR INFRAGENERIC TAXON	COMMENTS ON THE NATURALNESS OF THE TAXON i.e. VALUE FOR ZOOGEOGRAPHY	NUMBER OF SPECIES	DISTRIBUTION IN EAST AFRICA	GENERAL DISTRIBUTION	FOSSIL EVIDENCE	ZOOGEOGRAPHICAL CONCLUSIONS	SPECIAL POINTS OF INTEREST
SAULEA GRAY	Fair	0	Not now in East Africa	West Africa	Pleistocene (Kaiso) & Miocene (Kirimon)	Shows W. African influence in past	
LITTORINA PAYRAUDEAU (Melarhaphe Menke)	Good	3	Mangrove swamps and rocks just above high tide level	Worldwide	Post Pliocene (Mombasa)		
OTOPOMA GRAY	Fair	1	Extreme N.E. corner of Kenya; arid bushland	Arabia, Socotra and Somali Republic			Records from Zanzibar probably erroneous. Including *Georgia* Bgt. etc.
TROPIDOPHORA TROSCHEL (subg. LIGATELLA VON MTS.)	Good	c12	Widespread but essentially dry bushland & coastal forest; rarely in montane or other wetter evergreen forest	Widespread on eastern side of Africa from Port Elizabeth to Somalia & Ethiopia, S. Congo, Malawi, NE. Rhodesia, Madagascar, Mauritius, Reunion, Comoro Is., Seychelles, not in W. or N. Africa	Miocene (Kavirondo)		Revision badly needed: number of species dubious. One species on Marsabit Mt. in forest is an inexplicable anomaly
GABBIELLA MANDAHL-BARTH	Good	11	Predominantly in the Great Lakes, not common elsewhere	Widespread in tropical Africa, not in W. Africa, save Cameroun and Chad	Quaternary (L. Rukwa), Pleistocene (L. Albert, L. Edward & Egypt), Middle Pleistocene (L. Natron)		One in L. Nyasa

Incertihydrobia Verdcourt	Good	1	Kenya; coastal swampy lakes	Not known elsewhere			
Truncatella Risso	Good	3	Mangrove swamps above high tide mark	S.&E. coasts of Africa; worldwide. E. African spp. extend to Red Sea, Port Elizabeth, Rodriguez, Mauritius & Australia	Widespread in Palaeocene		Species poorly delimited
Assiminea Fleming	Good	2	Coastal, also rivers of arid steppe in Kenya	Worldwide with mainly tropical distribution rather concentrated in the Indo-Malayan region	Jurassic of Scotland perhaps		Recently suggested that the species occurring in Britain & NW. Europe is an introduction from China
Potadoma Swainson	Good	1	Congo-Uganda border	Liberia to Lower Congo, E. Congo, SE. Central African Republic		A possible relationship with New World Pleuroceridae has been recently doubted	Smith's record from Lake Albert is doubtful but genus may occur in W. Uganda
Potadomoides Leloup	Good	1	Lake Tanganyika	Several in Congo Republic			Mandahl-Barth has recently transferred several spp. formerly included in *Potadoma*
Cleopatra Troschel	Good	12	Widespread	Nile area, Central Africa & E. Congo, Madagascar; not so common in W, S, or NE.	Pleistocene (Egypt, L. Rudolf & Kaiso), Pliocene (L. Nyasa), Miocene (Kavirondo)		Several at present coastal spp. recorded from Kavirondo and Uganda in fossil deposits
Bathanalia Moore	Good	2	Lake Tanganyika	Endemic in Lake Tanganyika			

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Bridouxia Bgt.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Chytra Bgt.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika		The curious marine appearance gave rise to early theories that L. Tanganyika was a relict internal sea once in contact with the ocean. This is untrue. These endemic genera are derived from Melaniid stock evolved over a long period of time in a large lake which did not dry up during the interpluvials. The incredible diversity is partly due to the fact that the lake became three separate lakes during the driest of these periods thus aiding evolution by isolation. Marine conditions including this continuity (unusual for a freshwater habitat) have caused convergence with marine forms.	
Edgaria Bgt.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika	Quaternary (L. Rukwa & Lower Ruzizi)		5 forms; Leloup may have sunk too far here
Hirthia Ancey	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Limnotrochus Smith	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Paramelania Smith	Good	2	Lake Tanganyika	Endemic in Lake Tanganyika			Including *Bythoceras* Moore
Reymondia Bgt.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Spekia Bgt.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Stanleya Bgt.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Stormsia Leloup	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Tanganyicia Crosse	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			

Tiphobia E.A. Sm.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
"Melania Sect. Horea Bgt."	Poor	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Mysorelloides Leloup	Poor	1	Lake Tanganyika	Endemic in Lake Tanganyika		According to Mandahl-Barth (*in litt.*) not a Bithyniidae but a 'Paramelanian'	Formerly referred to the Indian genus *Mysorella*
Thiara Röding	Good	1	Coastal rivers	E. African sp. ranges from Somaliland to S. Africa. Similar forms in Comoro Is., Mascarenes, Madagascar, Japan, Philippines, N. Australia, Pacific islands			
Melanoides Oliv.	Good	4	One L. Tanganyika endemic; one doubtful, one Kenya coast & one generally distributed	The widespread sp. *M. tuberculata* is spread over much of Africa but is absent from the Guinean region; it occurs in Asia to Burma, Java, Australia, islands of the Indian & Pacific oceans and S. Mediterranean	Miocene (Turkana). Widespread in Pliocene and Pleistocene deposits (Egypt to Malawi)		5 additional endemics in L. Nyasa
Anceya Bgt.	Good	2	Lake Tanganyika	Endemic in Lake Tanganyika			

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Martelia Dautz.	Good	1	Lake Tanganyika	Endemic in Lake Tanganyika			
Syrnolopsis E.A. Sm.	Good	2	Lake Tanganyika	Endemic in Lake Tanganyika			
Cerithidea Swainson	Good	1	Mangrove swamps	Eastern coast of Africa, Asia, Indopacific	Widespread in Upper Cretaceous		Several other Potamididae e.g. *Terebralia* are mangrove dwellers. The division between marine & non-marine is tenuous here
Afrocanidea Connolly	Poor	1	Kenya: Shimba Hills	Endemic		Distinct Asiatic affinity	Thiele suggests synonymy with *Clea* one of the few freshwater Buccinids; African sp. has never been recollected
Melampus de Montfort	Good	9	Above high tide level	Throughout warmer parts of the world	Jurassic (Purbeck) Post Pliocene (Mombasa)		Material is hopelessly confused – probably far fewer spp.
Pedipes Fér.	Good	1	Above high tide level	Throughout warmer parts of the world			
Plecotrema H. & A. Adams	Good	1	Above high tide level	Indopacific and one in West Indies	Oligocene (Europe)		

BLAUNERIA SHUTTLEWORTH	?	1	Above high tide level	Warmer areas of Old and New Worlds			E. African species very recently recorded from Diego Garcia
AURICULODES STRAND	Good	2	Above high tide level	Indopacific	Eocene (Europe)		
AURICULASTRA VON MTS.	Good	1	Above high tide level	Indopacific	?Miocene (Europe)		
CASSIDULA FÉR.	Good	2	Above high tide level	Indopacific	Miocene (Europe)		
PHYSA DRAP.	Good	1	Uganda: Kampala. Kenya: Nairobi & Lake Naivasha	Doubtful if any native to Africa but several described; cosmopolitan	?Upper Carboniferous (Europe)		Probably introduced by migrant birds; formerly thought to be the Mauritian sp. *P. borbonica* but that is also nothing but *P. acuta* the widespread species
LYMNAEA LAM.	Good	3	Generally distributed	Worldwide. The common *L. natalensis* extends to Arabia	Palaeocene (Europe) Widespread Pliocene to Recent		It is not clear if the species occurring in the Kenya & W. Usambara highlands is identical with *L. truncatula*. Opinions differ
BULINUS MÜLL.	Good	13	Generally distributed, mostly rare in highlands but one in mountain tarns on Kenya & Elgon, common at coast	Generally distributed in Africa, S. Europe, Arabia, Asia Minor, Madagascar, Australia	Pliocene and Pleistocene		§ Physopsis restricted to Africa. Additional species in L. Nyasa. 18 races in E. Africa

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BIOMPHALARIA PRESTON (conserved name)	Good	6	Generally distributed, not in montane areas nor much near the coast	S. Africa to Arabia, Cameroun, S. Sudan. Accepted to = *Australorbis*, *Tropicorbis*, *Taphius* & *Planorbina*, all from tropics of New World	Pleistocene (Tribe known from Oligocene & Lower Miocene of both Africa & America)	Distinct neotropical affinity	No. of sp. very controversial; 11 races have been kept up in the past but many not now regarded as valid
ANISUS STUDER	Good	2	One generally distributed & one rare	Mainly Palearctic, widespread in Africa	Widespread in Pleistocene	Rare species is the one with mainly W. African distribution	Very closely allied to *Gyraulus*
GYRAULUS CHARP.	Good	8	Generally distributed	Probably cosmopolitan	Pleistocene		
LENTORBIS MANDAHL-BARTH	Good	2	One generally distributed; one Lake Tanganyika	Restricted to tropical Africa			
SEGMENTORBIS MANDAHL-BARTH	Good	4	Generally distributed, but not coastal	Restricted to tropical Africa where widely distributed save rare in W. Africa	Widespread sub-fossil. Gamblian (Nakuru)		Possibly only two species
UNKNOWN GENUS	—	1	Kenya coast				Resembles *Bathyomphalus* but hardly that genus
BURNUPIA WALKER	Good	5	Generally distributed	S. Africa to E. Africa and Ethiopia	Pleistocene		No. of species very dubious

Ferrisia Walker subg. Pettancylus Iredale	Good	?7	Generally distributed	W., E. & S. Africa	Genus known from Eocene (Europe)		No. of species very dubious
Pseudoveronicella Germain	Good	1	Uganda, evergreen forest	Mostly W. Africa (including Fernando Po), Congo, one also in Ethiopia; rain forest		Possibly neotropical affinity	
Laevicaulis Simroth	Good	7	Coastal bush to evergreen forest at 5500 ft.	Eastern coast of Africa from Cape Prov. to Somali Republic, extending to Central Africa with outliers to Sudan, Chad, Rhodesia. Essentially not W. African – only near Congo estuary; not predominantly rain forest. One sp. *L. alte* extends to the Malagasy Region, Asia, Australia, New Caledonia & the Loyalty Is. General distribution Indo-Malaya, W. Polynesia, Australia			Some of the exceptional distribution may be due to accidental transport. The same may be said of the distribution of *L. alte*. The distribution probably does not indicate an ancient species but a recent artificial extension of distribution from an unknown origin
Filicaulis Simroth	Good	1	Kenya Coast	Malagasy area, also one in Indonesia			

GENUS OR INFRAGENERIC TAXON	COMMENTS ON THE NATURALNESS OF THE TAXON i.e. VALUE FOR ZOOGEOGRAPHY	NUMBER OF SPECIES	DISTRIBUTION IN EAST AFRICA	GENERAL DISTRIBUTION	FOSSIL EVIDENCE	ZOOGEOGRAPHICAL CONCLUSIONS	SPECIAL POINTS OF INTEREST
"SUCCINEA DRAP."	Very poor	?11	Widespread; seasonally wet arid ground, under tree bark, etc.	Worldwide in broad sense. Widespread in Africa extending to Eritrea & Somali Republic (N.)	Pleistocene ("Genus" from Upper Palaeocene (Europe))		Probably the typical genus *Succinea* does not occur in Africa; Quick examined a few animals from E. Africa and pronounced them to belong to a group of the genus he did not know. Until a general revision is carried out there is no hope of knowing how many genera nor of unravelling the species. These are at present impossible to name honestly
NEGULUS BOETTGER	Good	1	Mt. Kenya, 6000–9000 ft.	E. Congo, Ethiopia, ?St. Helena	Tertiary (Europe)		Never recollected?
TRUNCATELLINA LOWE	Good	4	Few records but probably generally distributed. Not in lowlands. Kenya: Naivasha, Aberdares, Elgon. Uganda: L. Mutanda. Tanzania: New Moshi	Atlantic Islands, Madeira (fossil), Canaries & Cape Verdes, Europe, Asia to W. Himalayas, Loochoo Is., Ethiopia, S. Africa, Congo Republic	Upper Oligocene (Germany), Miocene (Germany)	Migration from Europe to S. Africa along mountains but probably of ancient origin	*Franzia sinistrorsa* Blume described from the Aberdare Mts. is only a race of *Truncatellina pygmaeorum* (Pilsbry) which occurs in the Congo Republic (Katanga & Kivu)

Nesopupa Pilsbry	Good	3	Single record of each, Rumuruti to Mt. Kenya; Malagarasi Delta	Africa (Ethiopia, Congo, Rhodesia, Mozambique, S. Africa) islands of Indo-Pacific, Orient, St. Helena	Upper Oligocene, Pliocene (Europe)	Very ancient palaeotropical group	
Pupilla Leach in Fleming	Good	2	Kenya: Naivasha, near Mt. Kenya	Cape Verde Is., Somali Republic, Ethiopia, S. Africa; N. America, Eurasia, Australia, mostly in temperate or cold regions. E. African sp. occurs in S. Africa, Somali Republic and Ethiopia	Upper Oligocene (Central Europe), Miocene (Europe), Pliocene (U.S.A.)	Tropical African ones presumably relicts of migration route from Europe to S. Africa or vice versa. Somaliland & E. African shells of *P. fontana* are probably of S. African origin i.e. a secondary migration	
Pupoides Pfr.	Good	1	Widespread in lowland arid bushland, 0–3000 ft.	E. African spp. in India, Afghanistan, Iraq, Aden, Arabia, Egypt, Somali Republic, Ethiopia, Senegal, Cape Verde Is., Rhodesia, Bechuanaland, Angola, SW. Africa & S. Africa. Introduced in S. Africa, Cuba, etc. Genus as a whole occurs on all continents save Europe	?Oligocene (Florida)	The Afroasian 'super-species' follows the well known arid distribution from India across to Senegal and through E. Africa to S. & SW. Africa. Pilsbry suggests that *Microstele* spp. are surviving representatives of the stock that gave rise to *Pupoides*	3 races

GENUS OR INFRAGENERIC TAXON	COMMENTS ON THE NATURALNESS OF THE TAXON i.e. VALUE FOR ZOOGEOGRAPHY	NUMBER OF SPECIES	DISTRIBUTION IN EAST AFRICA	GENERAL DISTRIBUTION	FOSSIL EVIDENCE	ZOOGEOGRAPHICAL CONCLUSIONS	SPECIAL POINTS OF INTEREST
MICROSTELE BOETTGER	Fair	1	Kenya: Seasonally wet bushland, Eusso Nyiro & Ukamba	India, Ceylon, SW. Africa	Miocene (Europe) & possibly Oligocene (Tampa, Florida)	One of the few molluscan examples of a distribution known for several score of plants which hints at a narrow corridor between NE. & SW. Africa	It has been suggested that the SW. African sp. is not congeneric with the E. African; certainly odd teeth can be found in some *Pupoides* in E. Africa
LAURIA GRAY	Good	1	Kenya: Mt. Kenya, 9000–10000 ft. & Kinangop, about 13000 ft.	Palaearctic & Ethiopian regions. Spp. in Somali Republic, Ethiopia, Madeira, Canary Is., Réunion, S. Africa	Tertiary (Europe) (Upper Oligocene onwards)	A very ancient genus. Presence in Azores, St. Helena & Jamaica probably due to importation. E. African records may be relicts of migration route between Europe & S. Africa	Some S. African spp. clearly are distinct, others may be imported from Europe but have different names
GASTROCOPTA WOLLASTON	Fair	2	One at 9100 ft. on Kilimanjaro, the other widespread in 'dry' bushland (*G. klunzingeri*) Kenya: Machakos, Turkwell R. drift, Eusso Nyiro & Gazi. Tanzania: Dar-es-Salaam	*G. klunzingeri* occurs in Ethiopia, Congo Republic, Senegal. Genus is very widespread, practically world-wide but lacking in recent European fauna	Middle Oligocene (Germany) then abundant until Pliocene in Europe	Pilsbry suggests main evolution in Holarctica then Tertiary spread elsewhere. Remarkably wide distribution of two spp. in Polynesia perhaps due to movement of islanders and later commerce	Has the widest distribution of any Pupillid genus. Probably originated in Cretaceous

PUPISOMA STOLICZKA	Fair	2	Kenya: Nairobi 5500 ft., Mt. Meru 6000 ft. & Mt. Kenya	*P. orcula* occurs in Japan, India, Philippines, Java, Mauritius, S. Africa, Rhodesia, Ethiopia & Congo Republic. About a dozen spp. in tropical and subtropical regions of both hemispheres save in arid areas & oceanic islands			Presence in S.&E. Africa of *P. orcula* perhaps due to transport of plants etc. since they live on shrubs and tree bark. *P. renschi* (not congeneric?) is certainly indigenous
ACANTHINULA BECK	Fair	3	One Mt. Kenya 9000–10000 ft. & Igembi Hills 6000 ft.; one Uganda: Mbarara to Kigezi and one undescribed from Kenya: L. Naivasha	Uganda one, if correctly named, also occurs in the Azores. One also once recorded for Ethiopia. Others in Congo Republic & Oubangui – Chari. Common *A. aculeata* is widespread in W. Palaearctic	Tertiary (from base of Palaeocene) (S. & Central Europe)	Mt. Kenya sp. is very close to European *A. aculeata* and needs comparison with fresh material. Obviously immigrants from Europe	Known only from four gatherings in E. Africa
RACHIS ALBERS	Good	2	Common in coastal & lowland bushland	The common species *R. punctatus* occurs in India & Ceylon & in Africa extends to Rhodesia, Mozambique, Somali Republic, Transvaal & Angola. According to Connolly only to Mozambique with related spp. in other areas		Pilsbry (1919) suggests occurrence in Angola is due to importation by Portuguese on timber from India. Possibly originally purely Indian	Position of second E. African sp. doubtful. *R. punctatus* is particularly abundant near coastal ports and very prolific and often arboreal

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RHACHIDINA THIELE	Poor	8	Generally distributed both in dry bushland & forest at low & fairly high altitudes	Mainly Mozambique to N. Natal, Malawi, NE. Congo Republic & Katanga. Spp. from India & Philippines are obviously very close to African spp.			Often arboreal
RHACHISTIA CONNOLLY	Poor	10	Coastal & lowland bushland, some spp. in quite arid areas	Mainly Ethiopia, Somali Republic, Mozambique to N. Natal, Rhodesia, Zambia, Malawi, NE. Congo Republic. Species have been reported from India, China, Celebes, Australia, Philippines, New Caledonia & New Hebrides		I agree with Solem that Asiatic spp. e.g. *R. histrio* & *R. zonulatus* are probably early introductions from Africa. They are closely similar to *R. braunsii* usually referred to the previous genus	Often arboreal

Edouardia Gude	Fair	18	Predominantly lowland with few over 5000 ft. Some in rather dry bushland under shrub bark. Widely distributed	Widespread, particularly in E. S. Africa but extending to SW. Africa; also in Central Africa and Ethiopia	Shells possibly belonging here in Miocene (Kavirondo)	Would appear to be a S. African group in origin which has migrated up the coast	One sp., perhaps doubtfully congeneric, pinpoints affinity of Kenya & Tanzania coastal forests namely *E. alycaeoides* at Jilori, Mrima Hill & Kimboza. One of the typical broad S. African group of this genus has been found on the Kenya coast but unfortunately it was loaned to America and not returned. Essentially arboreal
Cerastua Strand	Fair	8	Group A occurs in W. Uganda. Group B in E. African highlands (but missing from Usambara, Uluguru, Nguru area). Group C only in extreme NE. tip of Kenya	Group A in E. Congo; Group B extends to E. Congo, S. Sudan & Ethiopia; Group C in drier parts of Ethiopia, Somali Republic, Arabia & India	Probably in Miocene (Kavirondo)		Groups A & B are clearly congeneric but anatomical evidence is needed in case of Group C. Miocene spp. possibly related to Somaliland spp.
Conulinus Von Mts.	Fair	4	Upland evergreen forests including drier types but not on Mt. Kenya nor Usambara, Uluguru & Nguru nor in S. Tanzania	E. Congo, S. Sudan			Probably closely related to *Cerastua*
Limicena Connolly	Fair	1	S. Tanzania	Mozambique, Malawi, Zambia			

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Macroptychia Boettger	Fair	3	Kenya: Mt. Kenya, Mau Escarpment, Laikipia, S. Lake Tanganyika	Also in Arabia, Somali Republic (N.) & Ethiopia		Probably derived from European genera	Known only from a few specimens
Austrobalea Pilsbry	Poor	1	Reported from Kenya: Naivasha, Uganda: Moroto	Natal & Cape Province		In each case the record probably refers to a juvenile of *Macroptychia*	Probably a section of *Macroptychia*
Cecilioides Fér.	Good	3	Uganda: Ruwenzori & Mbarara. Kenya: Naivasha, Eusso Nyiro to Marsabit, R. Turkwell Drift, Mt. Elgon. Zanzibar	W. & S. Europe, S. Asia, few in tropics of both hemispheres, S. Africa, Ethiopia, Congo Republic, Bechuanaland	Upper Miocene (Europe)	Connolly suggests *C. tribulationis* from Naivasha might equal *C. gokweanus* O. Bttgr. from Bechuanaland & the Transvaal; he also records the Natal *C. pergracilis* from Zanzibar	
Subulina Beck	Good	15	Widespread	One sp. *S. octona* is widespread in the tropics. Others in tropical America, W. Africa, Ethiopia, Somali Republic, Rhodesia, Arabia & Comoro Is.		In the natural state probably genuinely native to tropical America & Africa	
Nothapalus Von Mts.	Good	22	Widespread in highlands, mostly Uganda & W. Kenya to 10000 ft.	E. Congo Republic, Ethiopia		Seemingly a restricted group but species may be masquerading in other genera	Number of species probably much exaggerated

Bocageia Girard	Poor	5	Uganda: Elgon & Ruwenzories. Tanzania: Crater Highlands	*Bocageia* proper in Princes Is.; *Petriola* on Gulf of Guinea islands & Comoro Islands. E.A. & E. Congo Republic group is *Liobocageia* and also occurs on Buka Mts. in Ethiopia. A *Petriola* is reported from the Andaman Islands		One species *B. bukaensis* occurs in both Uganda (Elgon) & Ethiopia (Buka)	Anatomical work may show more than one genus involved
Subuliniscus Pilsbry	Good	10	Widespread in evergreen forest, mostly upland	E. Congo Republic, Malawi, E. Rhodesia, Mozambique	Pleistocene		Number of species probably exaggerated
Ceras Dupuis & Putzeys	Poor	1	S. Tanzania	Cameroun, Congo Republic			One or two lowland *Subulona* may belong here
Subulona Von Mts.	Good	27	Widespread, predominantly in upland evergreen forest but some in lowland areas	W. Africa (Sierra Leone) to Angola, Congo Republic, Ethiopia, Somali Republic, Sudan Republic, Mozambique	Miocene (Songhor)		
Oreohomorus Pilsbry	Good	20	Widespread in upland evergreen forest	Cameroun, E. & W. Congo Republic			
Pseudoglessula Boettger subg. Ischnoglessula Pilsbry	Good	5	Evergreen forest in Uganda & W. Kenya	Liberia, Cameroun, Gabon, Congo Republic			Considered a subg. of *Subulona* by Thiele

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subg. Pseudoglessula (incl. Kempioconcha Preston)	Good	34	Widespread in lowland & upland evergreen forest, also evergreen bushland	W. Africa to Angola, Congo Republic, Ethiopia, Mozambique, Malawi, Rhodesia, Natal		The very common *P. boivini* has adapted itself to rather poorer conditions	Does not extend high on mountains
Krapfiella Preston	Good	3	Evergreen forests in Kenya, 5000–6000 ft.	Not recorded outside of Kenya	Miocene (Songhor & Koru)		A remarkable genus related to *Pseudoglessula* unlikely to have evolved in Kenya & probably once more widely distributed
Mabiliella Ancey	Poor	1	"Lake Nyasa to the East Coast" presumably in S. Tanzania				Only found once and exact locality not known. Affinities not obvious. Thiele has referred this to *Cerastua* as a subg. but Connolly suggested the present position
Curvella Chaper	Good	24	Generally distributed	W. Africa, Congo Republic, Ethiopia (rare), Central Africa, S. Africa, India, Burma, Perak to S. China, Philippines, Cebu etc.	Pleistocene		Very many still unidentified

Hypolysia Melvill & Ponsomby	Poor	2	Tanzania: Usambaras	S. Africa (Natal & N. Transvaal)			Probably correctly considered a section of *Curvella* by Thiele & others but kept separate by Pilsbry & Connolly
Lamellaxis Strebel & Pfeiffer	Fair	1	Mainly in coastal areas, bushland, waste places, habitations etc.	Worldwide in tropics – spread by man			Very many so-called *Opeas* may belong here
Opeas Albers	Poor	24	Widespread in both evergreen forest & drier bushland	Throughout tropics & subtropics; not in Australia	Eocene		Probably covers several genera. Very many unidentified. Some groups e.g. *Nothapalinus* Connolly are probably distinct
Pseudopeas Putzeys	Poor	18	Widespread	Princes Is., W. Africa, Cameroun, Congo Republic, Ethiopia, Comoro Is. Also subg. *Dysopeas* in S. America & subg. *Eremopeas* in Australia & associated islands	Pleistocene		Australian & S. American forms may not be truly related
"Euonyma Melvill & Ponsonby" Group A	Good	3	Kenya: Mathews Range & Thika Gorge. Tanzania: E. Usambaras – Tanga	Neither of these East African groups appears to occur elsewhere		The disjunct distribution of Group A, the spp. of which are so close that Connolly united them, is very interesting	Neither group related to true S. African *Euonyma* but anatomy scarcely known.
Group B	Good	7	Kenya highlands				Too many species in Group B

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Zootecus West.	Fair	1	Arid areas of Kenya: Turkana, Northern Frontier Province	Burma, India, Arabia, Egypt, Eritrea, Ethiopia, Somali Republic, Socotra, Sudan, Senegal, Cape Verde Is.	Pleistocene (Egypt)	Bequaert (*in litt.*) suggests it probably owes its present distribution to human activity thus making its original home difficult to determine. I do not consider the evidence very strong	If the close placing near *Xerocerastus* Kobelt & Möllendorf by Thiele is correct (& on external characters & radula this seems likely) the pair supply another example of NE.–SW. arid corridor affinities
Achatina Lam. subg. Achatina	Good	2	W. Kenya & Uganda, in evergreen forest	Widespread in W., Cent. & S. Africa but only in W. part of E. Africa			
subg. Lissachatina Bequaert	Good	8–10	Widespread, forest & savanna	Widespread in eastern Africa from Somaliland to S. Africa, Congo Republic, Central Africa, Angola	Postpliocene, Pleistocene		Newton reports from Miocene of Kavirondo *A. fulica* spread throughout Mauritius, Asia & Pacific. Long known from Madagascar but perhaps not native there. Remarkable that no species has reached W. Indies
subg. Leptocallista Pilsbry	Good	2	Tanzania: Usambaras, Ulugurus & Ngurus, forest	Also in Ethiopia			

ARCHACHATINA (ALBERS) PILSBRY	Good	6	Uganda: W., S. & SW. Tanzania: Iringa, Rungwe, forest	W. Africa, eastern Africa from S. Africa to Ethiopia & Somali Republic (S), S. Sudan & E. Rhodesia		E. African spp. belong to different subgenus from W. African spp.
CALLISTOPEPLA ANCEY	Good	1	Recorded once from SW. Tanzania	W. Africa, Congo Republic		
BURTOA BGT.	Good	1	Uganda, W. & Central Tanzania, Kenya (Kavirondo), savanna & *Brachystegia* woodland	N. Cameroun, Chad, Central African Republic, Ethiopia (1 record), Congo Republic, Zambia, Rhodesia, Bechuanaland, Malawi	Miocene (Kavirondo)	4 rather diffuse races. The Miocene specimens are only racially distinct from present day *B. nilotica*
LIMICOLARIOPSIS D'AILLY	Fair	14	Save for 1 of doubtful affinity from extreme NE. Kenya, an arid area, all in upland evergreen forest on hills & mountains mostly at 5000–9000 ft.; in Tanzania only from Loliondo, Kilimanjaro & Meru	W. Congo Republic, Ethiopia, Somali Republic		*L. cylindrus* from NE. Kenya probably belongs elsewhere and may be an *Archachatina* or even a new genus
LIMICOLARIA SCHUM.	Good	7	Widespread but mostly absent from the coastal belt & inner arid belt. In forest, also seasonally dry grassland & bushland	Widespread in tropical Africa from 15°–16°N. Senegal, Sudan Republic, Ethiopia, down to Angola & Zambia. Mostly absent from the Horn	Miocene (Kavirondo), Pleistocene	

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Halolimnohelix Germain	Fair	13	Uganda: Ruwenzori. Kenya Highlands (including Mt. Kulal). Tanzania: Mt. Meru, Bukoba, Ukinga, E. Usambaras, in forest & also in rocky bushland mostly over 6000 ft. – never in coastal belt	E. Congo Republic	Pleistocene (Kenya)	Pilsbry states that the affinities of the tropical African Helicids are with groups from eastern Asia. Pollonera states that the Ethiopian genus *Lejeania* Ancey has a single dart sac on the atrium and is related to the European Helicids. One or two species described by Preston from coastal localities have been omitted as definitely erroneous	The genera are distinguished by characters of the genitalia but these do not correlate with shell shape, radula etc. Confirmation is needed that the genera are natural. Very similar species from high up on Mt. Kenya and Mt. Kilimanjaro prove to belong to different genera
Vicariihelix Pilsbry	Fair	6	Uganda: Ruwenzori. Kenya Highlands (including Mt. Kulal)	E. Congo Republic			
Haplohelix Pilsbry	Fair	6	Uganda: Ruwenzori. Tanzania: Kilimanjaro & Crater Highlands. Up to 13,500 ft.	E. Congo Republic			
Unplaced Helicidae		43	Uganda: Ruwenzori & SW. Uganda. Kenya: Elgon, Marsabit, Mathews Range, Larogi Hills, Mt. Kenya & Rumuruti. Tanzania: Mt. Meru, Kiboriani & Ukinga	Cameroun Mt., Central African Republic, E. Congo Republic, Somali Republic (N), Ethiopia, Malawi			

Punctum Morse	Good	3–4	Kenya: Rift Valley Escarpment?, Isuria Escarpment?, & Limuru. Tanzania: W. Usambaras, Kilimanjaro & Ngorongoro Crater; 6500–13500 ft.	Throughout northern hemisphere & in Mexico, Bermuda, Ethiopia, Mozambique, Bechuanaland, S. Africa	Upper Oligocene (Europe)	Fairly clear instance of use of tropical African highlands for migration south from Europe	Some not dissected may belong to *Trachycystis* (marked?)
Afrodonta Melvill & Ponsonby	Poor	1	Kenya: Igembi Hills & Cherangani Hills	S. Africa			No living material found; formerly tentatively placed in *Endodonta* but a very recent revision by Solem includes it in *Afrodonta*
Trachycystis Pilsbry	Fair	14	Kenya Highlands. NE. Tanzania: Meru area & W. Usambaras	S. Congo Republic, Malawi, Mozambique, Rhodesia, S. Africa			None of East African species is known anatomically. Generic reference dubious in some cases
subg. Psichion Gude	Good	1–2?	Evergreen forest in Kenya: Coast and Highlands. Tanzania: Usambaras	Comoro Is., S. Africa, Mozambique, Rhodesia			
Prositala Germain	Fair	1	Uganda: Toro	Fernando Po & Sierra Leone			Fide Connolly, I have not seen it

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Vitrina Drap.	Fair	16	Montane areas Ruwenzori, Mt. Kenya, Mt. Kilimanjaro & highlands extending from 5400–14700 ft. Hubendick reports examining one collected in the Usambaras (probably E. since collector was Conradt) i.e. at under 3200 ft.	Widespread in N. America, Europe, Greenland, Iceland, Siberia, Algeria, Ethiopia, Somali Republic, Arabia	Oligocene (Europe)	A wide gap separates the East African species from the rest of the distribution but Hubendick has pointed out that in anatomy they have diverged very little. Pilsbry had much earlier indicated shell & radula differences	Number of species is very doubtful and generic placing of some of the names is very doubtful. Shells alone are sometimes difficult to distinguish from those of Helicarionidae
Phenacolimax Stabille	Good	1	Uganda: Muhavuru (10960 ft.). Mt. Kenya	Ethiopia, Arabia, Atlantic Islands, Europe including Britain (subg. *Arabivitrina* in Ethiopia & SW. Arabia)	Oligocene (Europe)	Distinct Afroalpine-Arabia link	
Leptichnus Simroth	Good	?2	Tanzania: E. Usambaras	Forcart has recently described a species from Amatongas Forest in Mozambique which also occurs in Rhodesia in the Chirinda Forest		The distribution confirms a well known pattern of plant distribution	Type of genus is from "Deutsch Ost-Afrika" without any further locality. Forcart suggests it might have been Bagamoyo

Phaneroporus Simroth	Good	2	Tanzania: E. Usambaras				One of the species was described without locality data although Thiele later said 'Tanganyika–See!' Never recollected
Atoxon Simroth	Good	17	Evergreen forest & bushland. Uganda: Kigezi, Ruwenzori, Entebbe, Ankole, Busoga, Moroto. Kenya: Nairobi, Kikuyu, Marsabit. Tanzania: Bukoba, Kilimanjaro, Seronera, Mahali Mts., Kalinzi, Kome Is., Tukuyu. Mostly 3000–7000 ft.	Somali Republic (N), Ethiopia, E. Congo Republic, Mozambique, Malawi, Lower Congo, Rhodesia, Natal (Zululand)	Some shells from Kavirondo Miocene may belong here		The species are exceedingly poorly delimited and very much more work is needed
Dendrolimax Heynemann	Good	2	Uganda (W.). Kenya: Thika Gorge	W. Africa (Principe, S. Tomé, Ghana, Cameroun Republic), E. Congo Republic, Rhodesia (Chirinda Forest)		Distinctly W. African affinity. According to Forcart the S. Tomé species also occurs in Rhodesia	
Bukobia Simroth	Fair	8	W. Uganda. Kenya: Mt. Kenya, Kikuyu, Ngong Hills. Tanzania: Bukoba, S. Lake Victoria, Iringa, Sao Hill	E. Congo Republic			Pollonera referred two Uganda species to *Microcyclus*, a W. African genus

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Urocyclus Gray subg. Urocyclus (= Spirotoxon Simroth)	Good	2	Bagamoyo & other Tanzania without locality	Ethiopia?, Mozambique, E. Rhodesia			
subg. Elisolimax Cockerell	Good	8	Kenya: Kilifi, Kwale. Tanzania: E. Usambaras, Lindi, Pemba I. Lowland rain forest	Mozambique, E. Rhodesia, Natal, Transvaal, Comoro I., Madagascar			Recent work by Forcart has necessitated considerable alterations in the nomenclature previously used by me. This is due to the fact that he had good material of the genotype of *Urocyclus* to hand. The former *Trichotoxon* (with 4 subgenera) has to be merged with *Urocyclus*
subg. Polytoxon Simroth	Good	8	Uganda: Ruwenzori. Kenya: Mt. Kulal, Kavirondo, Molo, Kabarnet, Kitale, Nairobi, Thika, Ruiru, Machakos, Lukenya, Lolgorien, Isuria Escarpment. Tanzania: Ufiome, Arusha, Kilimanjaro, Ngorongoro, Bereku, Kondoa, Mto-wa-Mbu; Upland evergreen forest 4000–10000 ft.	SE. Sudan Republic, E. Congo Republic			There is a record from Magila near Pangani but it is the only lowland one. No. of spp. probably exaggerated

subg. Trichotoxon Simroth	Good	15	Uganda: Sesse Is. Kenya: Coast, Teita, Highlands, Nyambeni Hills, Meru, Mt. Kenya, Gatamayo, Thika, Ol Donyo Sabuk, Aberdares, Nairobi. Tanzania: E. Usambaras, Tongwe, Kilimanjaro, Pemba I. Rain forest & other evergreen forest – extends lower than other subgenera to sea level – also recorded up to 10000 ft.	E. Congo Republic	Some shells from Kavirondo Miocene may belong here		Number of species is probably too high
subg. Atrichotoxon Simroth	Poor	4	Kenya: Bura Hills, Nairobi. Tanzania: E. Usambaras. Evergreen forest, 3000–7250 ft.				Subgenotype was described from E. Africa without further locality
Durgelline slug of unknown position		1	Tanzania: E. Usambaras				Possibly a shell-less member of Durgellinae but genitalia resemble *Leptichnus*

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Kaliella Blanford	Poor	4	Uganda: Ruwenzori, Kigezi, Elgon. Kenya: widespread mostly 4000–8000 ft. but also on Mrima Hill (600 ft.). Tanzania: Usambaras, Ulugurus, Mahari Peninsula. Widespread in evergreen forest	The commonest sp. *K. barrakporensis* (Pfr.) occurs in India, Burma, Ceylon, Madagascar. In Africa recorded from E. Congo Republic, Ethiopia, Natal, Transvaal, Mozambique. Other spp. occur in Rhodesia		It has been suggested that *K. barrakporensis* is introduced in Africa but it is present in so many isolated evergreen forests that this seems unlikely	The four are are almost certainly not congeneric. Many of the numerous Indian spp. referred to the genus may also not be congeneric
Guppya Mörch	Poor	2	Kenya, widespread in evergreen forest. Tanzania: W. Usambaras. 5–8000 ft.	S.N. America, Middle America, S. Rhodesia, perhaps Mauritius			Tentatively referred here by me since so out of place in *Thapsia*. Possibly allied to certain Pacific genera e.g. *Liardetia*
Afropunctum Haas	Poor	1	Bushland. Uganda: W. Nile. Kenya: Turkana, Turkwell R. Tanzania: Zanzibar, E. Usambara foothills, Magila, possibly Kigoma	Congo Republic (Katanga), Victoria Falls on Zambia-Rhodesia border	Quaternary (Tibesti)		Living material needed. It might be an Endodontid as originally proposed

Afroconulus Van Mol & Van Bruggen	Good	5	Evergreen forest 3000–8000 ft. Uganda: Kampala. Kenya: Kakamega, Cherangani, Turi, Nairobi. Tanzania: W. Usambaras	Camerouns, E. Congo Republic, Ethiopia, Mozambique, Natal.			The species were formerly included in *Coneuplecta* Moellendorf which occurs in India?, Japan, Philippines, New Guinea, Java, Australia, Indo-Pacific islands
'Sitala H. Adams'	Poor	2	One widely distributed in coastal forest, the other in Tanzania: Usambaras, Nguru Mts., Tanga	Mozambique		Thiele has placed a Cameroun sp. in *Sitala* (*S. bifaris* Dohrn) but Zarate maintains in T*rochozonites*. Distinctly oriental affinity. The radula clearly shows that these cannot be placed in Baker's Urocyclinae	Doubtful if the two E. African spp. are congeneric & if either is congeneric with *Sitala*
Trochozonites Pfeffer subg. Trochozonites	Good	3	Evergreen forest in Uganda under 4000 ft. One in Bura Hills, Kenya may belong here	Fernando Po, Cameroun, Congo Republic, Little Namaqualand			
subg. Teleozonites Pilsbry	Good	1	Evergreen forest in Uganda, 3200–5500 ft.	Congo Republic, Guinea, Cameroun, Central African Republic		A very clear W. African affinity	
subg. Zonitotrochus Pilsbry	Fair	7	Scattered in evergreen forest in Kenya & Uganda, 4000–8000 ft.	Congo Republic, S. Malawi			

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
unplaced		1	Tanzania: Mt. Meru 10000 ft.				
Trochonanina Mousson subg. Trochonanina	Fair	40	Widespread in coastal bush & forest & evergreen forest up to 8000 ft. Some live in seasonally wet scrubland	Liberia, Congo Republic, Sudan Republic, Somali Republic, Ethiopia, Zambia, Mozambique, Malawi, Rhodesia, Transvaal	Miocene (Kavirondo)		
sect. Bloyetia Bgt.	Poor	1	Arid bushland. Kenya: Nguruman Hills	Somali Republic, E. Ethiopia			Some doubt about the accuracy of the record from the Magadi area but many plants from there have Somali affinity
subg. Montanobloyetia Verdcourt	Fair	2–3	Kenya: Mt. Nyiro, Mt. Kenya, Tanzania: Kilimanjaro, Mt. Meru, 7000–9000 ft.				
subg. Plicatonanina Verdcourt	Good	1	Kenya: Mt. Kenya, Thika			Shell shows convergence with several Pacific island genera	
subg. Falloonella Preston	Good	2	Kenya: Mathews Ra., Kulal, Larogi Hills				Never dissected but shell is distinctive
subg. Sjostedtina Verdcourt	Fair	1	Tanzania: Kilimanjaro				

ZINGIS VON MTS.	Poor	1	Kenya: Teita Hills	Spp. from Mozambique, Rhodesia & S. Africa have been referred here			Until Teita sp. (the genotype) is dissected it will not be known if the extra-E. African spp. belong to *Zingis* or not
THAPSIA ALBERS (incl. GUDEËLLA PRESTON)	Poor	50	Widespread from coast to 11500 ft. but mostly in evergreen forest at medium altitudes	W. Africa, Gabon, Camerouns, S. Tomé, Central African Republic, Congo Republic, Somali Republic, Ethiopia, Arabia, Malawi, Mozambique, Rhodesia, Angola, Natal, Transvaal, Comoro Is., Rodriguez	Miocene (Kavirondo)		May cover several genera. The spp. are hopelessly confused and impossible to name at the present time. Until a general revision is carried out using anatomy nothing can be done. Many other genera in the world have almost identical shells even in different families
ZONITARION subg. ANGUSTIVESTIS PILSBRY	Good		2 may occur in Uganda	Congo Republic to W. Africa	Shells of this general group have been found in the Miocene (Kavirondo)	All formerly included in subgenera of *Helicarion* Fér. but researches by van Mol indicate that the African spp. are not closely related to the Australian & Asiatic spp. Pilsbry and later H. B. Baker both indicated that the Urocyclinae are a natural assemblage i.e. the Urocyclid slugs are nearer to the African *Helicarion*–like spp. than the latter are to true *Helicarion*. The shell similarity is due to convergence	
CHLAMYDARION VAN MOL	Good	?7	Upland evergreen forest, widespread	Extends to W. coast & N. to Sudan Republic, Congo Republic & Ethiopia			Formerly considered to be *Granularion* but the type of that has proved to be generically distinct as very recently shown by van Mol
GYMNARION PILSBRY	Good	3	Upland evergreen forest, mainly in west e.g. Uganda. Kenya: Kakamega forest	W. Africa to Zambia, Rhodesia, Mozambique & Angola			
DEGNERIA VERDCOURT	Good	1	Evergreen bushland? N. Kenya	Ethiopia			

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Published 'Helicarion' of Unknown Position	—	14	Upland evergreen forest. One described from Mombasa probably wrongly localised	W. Africa, Congo Republic, Somali Republic, Ethiopia			Until dissected the identity of these will not be known. Probably mostly *Chlamydarion*. There are also numerous unidentified collections
Unknown Helicarion-like Genus	—	4	SE. & SW. Tanzania			These have been referred to *Zingis* & *Nanina*. The shell has curious wavy microsculpture	Until animals collected no comments can be made on possible resemblance to Asiatic genera. Van Mol has recently dissected one sp. and referred it to *Zingis*
Tayloria Bgt.	Good	15	Evergreen forest & bushland. Kenya: Shimba Hills, Thika, Marsabit, Kakamega, Mathews Range. Tanzania: E. Usambaras, W. Usambaras, Nguru Mts., Tongwe Mt., Uluguru Mts., Ujiji	Ivory coast, Ethiopia (Jimma), Somali Republic (Bur Acaba), Congo Republic (Katanga); a distinctive subgenus in Somali Republic (N.)	Miocene (Kavirondo)	Seems to be lacking from the big mountains	*T.*? *ventrosa* described from Zanzibar probably does not belong to the genus

Gigantaxis Tomlin	Poor	1	S. Tanzania			Never recollected. Affinities not known – probably a *Gonaxis*. Type does not look adult
Gonaxis Taylor	Good					
subg. Gonaxis (Marconia)	Fair	7	Uganda: Ruwenzori. Kenya: Coastal forests. Tanzania: Coastal forests, Usambaras and western areas	Mozambique, Angola	Miocene (Kavirondo) mostly not ascribable to subgenera)	The distributions need working out with new anatomical data and are far from complete
subg. 'Marconia' Auctt.	Fair	10	Widespread in evergreen forest. Up to 10000 ft. in upland Kenya, some in coastal areas	E. Congo, Central African Republic, Angola	Miocene (Kavirondo)	
subg. Macrogonaxis Thiele	Fair	11	Coastal & upland forest to 5000 ft. also dry bushland mostly E. Kenya & Tanzania	Guinea, Somali Republic (S), Sudan Republic, Mozambique, Rhodesia, Angola		
subg. Afristreptaxis Thiele	Fair	3	Evergreen forest. Kenya: Mt. Kulal. Tanzania: Usambaras, Ulugurus	W. Africa, E. Congo Republic, Ethiopia		

GENUS OR INFRAGENERIC TAXON	COMMENTS ON THE NATURALNESS OF THE TAXON i.e. VALUE FOR ZOOGEOGRAPHY	NUMBER OF SPECIES	DISTRIBUTION IN EAST AFRICA	GENERAL DISTRIBUTION	FOSSIL EVIDENCE	ZOOGEOGRAPHICAL CONCLUSIONS	SPECIAL POINTS OF INTEREST
subg. PSEUDOGONAXIS THIELE	Good	4–5	Uganda: Ruwenzori, Elgon, Entebbe. Kenya: Marsabit, Kakamega, Naivasha, Melka Murri. W. Tanzania	W. Africa, E. Congo Republic, S. Sudan Republic	Miocene (Kavirondo)		
EDENTULINA PFEIFFER	Good	6	Mainly coastal forest & bushland in Kenya & Tanzania, but also evergreen forest. Kenya: Teita Hills. Tanzania: Usambaras, Ulugurus, Mt. Kungwe	W. Africa, Congo Republic, Socotra, Somali Republic (S), Madagascar, Comoro Is., Seychelles Is.	Miocene (Kavirondo)		
GONOSPIRA SW.	Good	1	Kenya: Shimba Hills, Malindi	Another sp. of Streptaxid in Malawi namely *Ennea hamiltoni* E.A. Sm. seems to belong here. Mauritius		Seems clearly congeneric with Mauritian spp. & is a link of great interest. It seems very unlikely that it represents a sp. introduced from Mauritius but not yet discovered there	Anatomical work is needed to make certain of the relationships, but it is most unlikely that the resemblance is merely due to convergence
STENOMARCONIA GERMAIN	Fair	1	Mt. Kenya; 10800–13100 ft.			Locally evolved	

Streptostele Dohrn subg. Streptostele	Good	38	Generally distributed (but not common in Tanzania) mostly in evergreen forest 0–10000 ft.	Fernando Po, Princes I., Cameroun, Congo Republic, Somali Republic, Arabia		
subg. Raffraya Bgt.	Good	11	Generally distributed, 0–8000 ft.	Cameroun, Congo Republic, Ethiopia, Sudan Republic, Rhodesia, Zambia		
subg. Graptostele Pilsbry	Good	3	Central Kenya, Mt. Elgon	Cameroun, W. Congo Republic		
subg. Tomostele Ancey	Good	1	Unconfirmed report	Fernando Po, Princes Is., Guinea, Congo Republic		
Varicostele Pilsbry	Good	6	W. Uganda. Kenya: Naivasha			
Ptychotrema Mörch			All evergreen forest species		Miocene (Kavirondo) not in any recognisable subgenus	
subg. Ptychotrema	Good	10	W. Uganda. W. Tanzania	Fernando Po, W. Africa, Congo Republic, Angola		All belong to section *Haplonepion* Pilsbry
subg. Ennea H. & A. Adams	Good	3	W. Uganda. W. Tanzania	Fernando Po, W. Africa, Congo Republic		

GENUS OR INFRAGENERIC TAXON	COMMENTS ON THE NATURALNESS OF THE TAXON i.e. VALUE FOR ZOOGEOGRAPHY	NUMBER OF SPECIES	DISTRIBUTION IN EAST AFRICA	GENERAL DISTRIBUTION	FOSSIL EVIDENCE	ZOOGEOGRAPHICAL CONCLUSIONS	SPECIAL POINTS OF INTEREST
subg. PARENNEA PILSBRY	Good	8	Uganda. Kenya Highlands & Shimba Hills. Tanzania: E. & W. Usambaras	Cabinda, Congo Republic, Somali Republic (N), Ethiopia			
GULELLA PFEIFFER					The genus is well represented in the Miocene (Kavirondo) but only in one instance is the sub-grouping certain; Pleistocene (Kenya)		
GULELLA (remaining after separation of distinctive groups)	Good	120	Widespread in most forests but also in thickets etc.	Tropical & S. Africa, Arabia, S. & E. Asia, W. Indies		The disjunct distribution of some spp. e.g. *G. handeiensis* (Kakamega, Mara & Usambaras) is interesting & suggestive. A variety of *G. tudes* (Kilimanjaro) occurs in Fernando Po	*Gulella* (*Huttonella*) *bicolor* is circum-tropical but has not been found in E. Africa so far as I am aware. The groups *Molarella* Connolly & *Paucidentina* Pilsbry have not been used since they are distinctly heterogeneous
PRIMIGULELLA PILSBRY	Good	6	Uganda: Ruwenzori. Kenya: Nyambeni Hills, Mt. Kenya. Tanzania: Ulugurus, Usambaras	E. Congo Republic	Miocene (Songhor)		
PLICIGULELLA PILSBRY	Good	9	Widespread but mainly in Kenya Highlands	E. Congo Republic, Malawi, S. Africa			

Cuspidata Verdcourt	Good	1	Tanzania: W. Usambaras		Possibly a specialised locally evolved derivative of the more widespread *G. radius*	
Mirellia Thiele	Good	1	Kenya: Mau Forest, Ngong Hills			
Silvigulella Pilsbry	Good	3	W. Uganda. Kenya: Kakamega, Eusso Nyiro	Congo Republic, Angola		
Pupigulella Pilsbry	Good	1	Uganda: Entebbe. Tanzania: Kungwe Mt.	Fernando Po, Cameroun, W. Africa, E. Congo Republic	The single species shows clear West-East affinities	
Mirigulella Pilsbry	Good	1	Kenya: Mt. Nyiro, Mt. Kulal		One of the few apparently endemic groups on these isolated mountains	
Aenigmigulella Pilsbry	Good	1	Tanzania: Usambaras & Ngurus		Probably endemic to NE. Tanzania rain forests	
Costigulella Pilsbry	Good	4	Kenya Highlands	Fernando Po, Liberia, E. Congo		
Avakubia Pilsbry	Good	1	Uganda: Entebbe	Fernando Po, Cameroun, E. Congo		
Tortigulella Pilsbry	Good	9	Uganda. Kenya Highlands. Tanzania: Usambaras	E. Congo		
Conogulella Pilsbry	Good	2	Uganda: Entebbe, Elgon	Fernando Po, Cameroun, E. Congo		Thiele treats f. *minor* D'Ailly & subsp. *polynematica* Pilsbry of *G. conospira* (von Mts.) as separate species

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Caelatura Conrad	Poor	13	Great Lakes, R. Nile. Kenya: R. Athi. Tanzania: coastal rivers	Central & E. Africa throughout the Nile, Réunion, Asia	Miocene (Kavirondo), Pleistocene		The taxonomy at generic level is confused. It is not evident how or if the African taxa are related to the Asiatic ones
Grandidieria Bgt.	Good	1	L. Tanganyika	Also in L. Nyasa			Fossils reported under this name by Fuchs are now placed in *Pseudobovaria* of which 2 spp. are known from Kaiso beds in Uganda
Mutela Scop.	Good	6	Great Lakes	Widespread in Africa	Miocene (Kavirondo), Pleistocene (L. Albert)	Mutelidae occur in S. America, Africa & Australia	
Pleiodon Conrad					Cretaceous (Egypt), Miocene (Kavirondo), Pleistocene (Kaiso, Lakes Edward. Albert & Rudolf)		Typical *Pleiodon* do not now occur in our area

subg. Cameronia Bgt.	Good	1	L. Tanganyika		Miocene (Kavirondo), also Kivu & Usumbura deposits		At present confined to L. Tanganyika
Aspatharia Bgt.	Good	13	Great Lakes & associated rivers. Kenya: coastal rivers & in N.F.P. Also seasonally wet areas such as Tanzania: Yaida Depression & Wembere Steppe	Widespread in Africa extending to Senegal, Egypt, Angola, S. Africa	Pleistocene		Too many spp. by probably 50%. The adaptations to seasonally arid conditions have been discussed by Dance (1958)
Brazzaea Bgt.	Good	1	L. Tanganyika				
Moncetia Bgt.	Good	1	L. Tanganyika				
Pseudospatha Simpson	Good	1	L. Tanganyika				
Etheria Lam.	Good	1	Great Lakes & associated rivers. Kenya: Athi R. & Mara R.	Distributed in drainage areas of R. Nile, R. Niger & R. Congo	Miocene (Kavirondo). Widespread in Pleistocene deposits	Fischer-Piette's (*Bull. Mus. Nat. Hist. Paris* (2) 17:41 (1945)) records for N. Madagascar suggests quaternary connection with Madagascar	Mandahl-Barth keeps in the Mutelidae; Yonge, Pain & others keep in the Etheriidae
Corbicula Meg. v. Muhlfeld	Good	1–2	Great Lakes. Kenya: L. Naivasha. Tanzania: coastal rivers	Widespread in Africa save N. Africa & Guinea; also in Madagascar, Arabia, Asia Minor, S. Asia, E. Asia, Malayan area, E. Australia, Tasmania, SE. Europe	Over much of Central & S. Europe in Pliocene & Pleistocene. Widespread in Pleistocene (Egypt & Lake Rudolf)	Related genus in S. America	Taxonomy in great confusion, probably all races of one species

Genus or Infrageneric Taxon	Comments on the Naturalness of the Taxon i.e. Value for Zoogeography	Number of Species	Distribution in East Africa	General Distribution	Fossil Evidence	Zoogeographical Conclusions	Special Points of Interest
Pisidium Pfeiffer	Good	12	Widespread, 2500–16000 ft.	Almost cosmopolitan	Upper Cretaceous – recent	*Afropisidium* occurs in Africa, New Zealand, S. America but not Europe	*P. casertanum* occurs almost throughout the world. *P. personatum* occurs in Uganda
Sphaerium Scop.	Good	4	Great Lakes. Kenya: L. Naivasha	Mainly holarctic but distributed over whole of Africa to Cape	?Upper Jurassic, Cretaceous – recent	Entered Africa from north. Missing from Oriental & Australian regions	
Eupera Bgt.	Good	3	Great Lakes, Victoria & Albert Nile. Kenya: Athi R.	Egypt, Congo Republic, S. Africa, Mauritius, Madagascar	Eocene (Europe, W. North America & China (refers to both genera))	What might be taken to show a link with S. America is a chance dispersal resulting from widespread extinction since the Eocene	Formerly considered synonymous with *Byssanodonta* D'Orbigny from Central & S. America but according to Mandahl-Barth this is incorrect

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MONODONTA (*OXYSTELE*) *FULGURATA* PHILIPPI, A SYNONYM OF *OXYSTELE VARIEGATA* (ANTON)

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and

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(*Read before the Society, 17 April 1971*)

INTRODUCTION

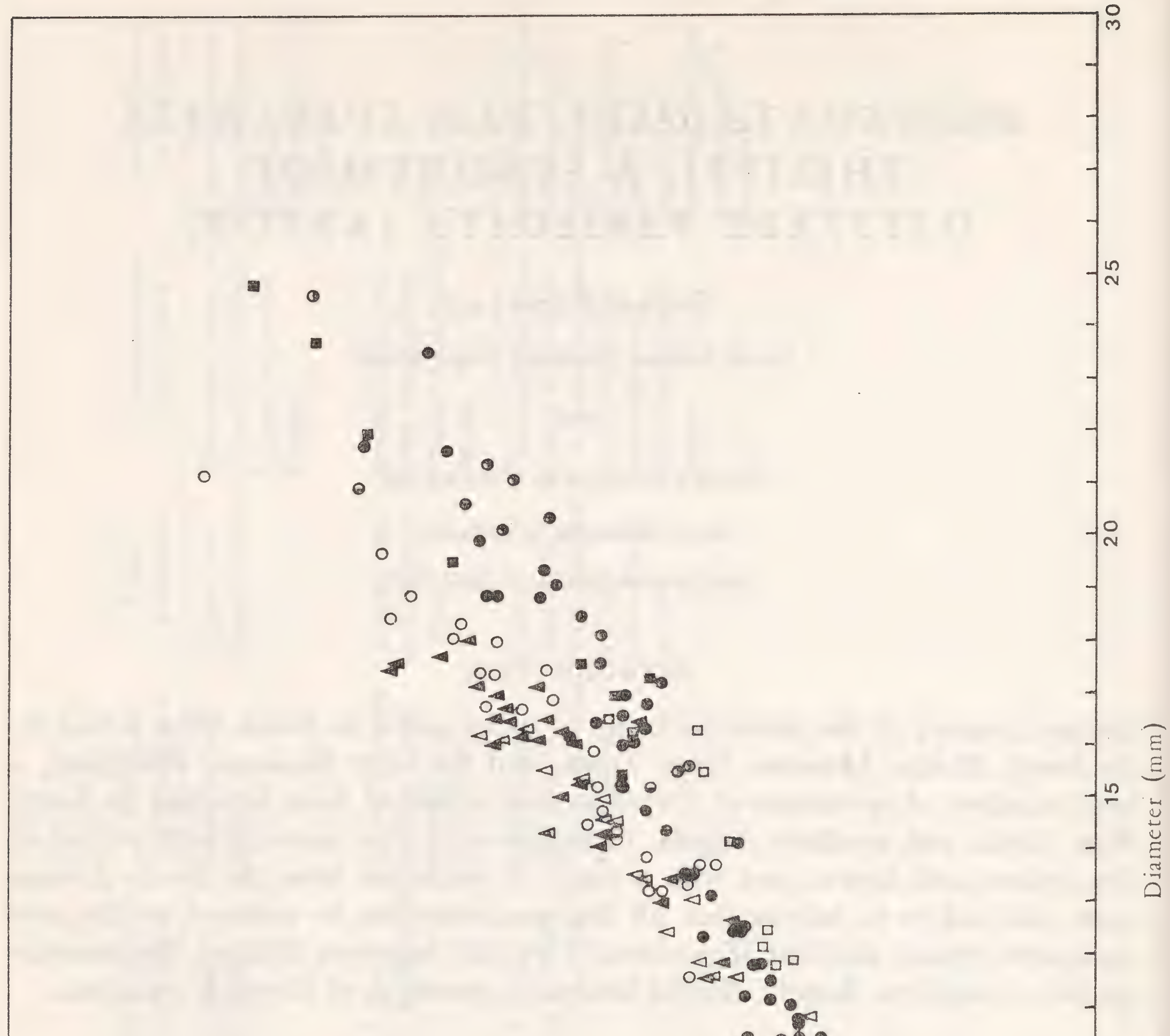
During a survey of the intertidal fauna of rocky shores in South West Africa by the South African Museum, Cape Town, and the State Museum, Windhoek, a large number of specimens of *Oxystele* were collected from localities in South West Africa and southern Angola. Comparison of this material with published descriptions and figures, and with a range of specimens from the South African coast, has led us to believe that all the specimens can be referred to *Oxystele variegata* (Anton), and that *Monodonta* (*Oxystele*) *fulgurata* Philippi, the common species of southern Angola, should become a synonym of *Oxystele variegata*.

BRIEF SYNONYMY

Trochus variegatus Anton, 1839 : 57.
Oxystele variegata : Barnard, 1963 : 268 (full synonymy).
Trochus fulguratus Philippi, 1848 : 106.
Monodonta (*Oxystele*) *fulgurata* : Nicklés, 1950 : 43; Franca, 1957 : 8, 1960 : 12.

DESCRIPTION

Protoconch plus six whorls. Protoconch and first whorl almost always eroded, not distinct in any of the specimens examined, second whorl with five or six lirae, third whorl with six to eight lirae, lirae obsolete on later whorls but 15–17 lirae visible on inner surface of outer lip in all but the largest specimens, where they become obsolete. Columella white, umbilicus closed at shell diameter of 5–6 mm. Radula of ±70 rows. Operculum horny circular, with concentric growth rings. Altitude of shell (base to protoconch) variable in relation to diameter, high or


○ Moçâmedes
● Rocky Point
● Swakopmund
● Luderitzbucht
□ Port Nolloth
■ Lamberts Bay
△ Sea Point
▲ Storms River
Diameter (mm)
Altitude (mm)
5
10
15
20
25
30
5
10
15
20

low forms occurring in the same population (Plate 1A), although the Moçâmedes, Storms River and Sea Point populations tended in general to have higher shells than those of Rocky Point, Swakopmund, Lüderitzbucht, Port Nolloth and Lambert's Bay (Fig. 1).

COLOUR VARIATIONS

Colour extremely variable, but, as stated by Barnard (1963) there is one constant feature, viz. a band under the suture of squarish dark spots, darker than the ground colour, alternating with pale spots. The ground colour varies from white, through yellow, grey, pink, green, red or brownish, to almost black. In the last case the dark spots below the suture merge into the ground colour, the light spots remaining distinct. The subsutural dark spots vary in number and size, and frequently give off dark flames which may form solid lines or have a zigzag effect. If the subsutural spots are few and large, the flames are broad, forming a few bold lines across the shell; if small and numerous, the lines are fine and if zigzag give a mottled or reticulate pattern. Occasionally the areas between the subsutural lines may be plain. The flames given off by the subsutural spots may be as dark as the spots, forming a maroon, dark brown, or black pattern on a white, yellow, pink, green, brown or red background; or they may be lighter than the spots. These forms with red lines on a white background are frequent. Several or all variations may occur in a single population; this is illustrated in Plate 1.

Inside of shell nacreous, with spiral lirae of body whorl distinct, becoming obsolete in very large specimens.

DISTRIBUTION

Nicklés (1950) gives the distribution of *Monodonta sagittifera* and *M. fulgurata* as Mauritania and Gabon to Moçâmedes respectively. With the lack of knowledge concerning the intertidal fauna of South West Africa, it is not surprising that this area represented a gap, with *M. fulgurata* to the north, and *O. variegata* to the south. *O. variegata* apparently occurs over the whole West African coast, as well as along the southern African coast. Barnard (1963) gave the eastern limit of distribution as Moçâmbique Island, and there is a specimen in the South African Museum collection to support this record. Mr. R. Kilburn, of the Natal Museum (personal communication) states that *O. variegata* does not occur on the Natal coast although the possibility of rare stragglers exists, and it seems probable that the normal range of distribution of *O. variegata* does not lie further north-east than Pondoland. It would seem that this species has a wide temperature tolerance, being found in both the tropical waters of the west African coast, the warm temperate waters of southern Angola and the eastern South African coast, as well as in the cold waters of the west coast of South Africa and southern South West Africa.

MATERIAL

Samples from the following localities were examined: Praia das Conchas, Moçâmedes; Rocky Point; Swakopmund; Lüderitzbucht; Port Nolloth; Lambert's Bay; Oudekraal; Mouille Point; Still Bay; Storm's River Mouth.

DISCUSSION

Barnard (1963) synonymised *O. sagittifera* with *O. variegata*. The figures of Nicklés (1950) show *M. sagittifera* as a flatter shell than *M. fulgurata*, with more noticeably zigzag markings. From the material we have examined it appears that marking and shell-forms are of little value in specific determination, as both are extremely variable (Plate 1, Fig. a). We can find no characters which could be used to separate the Angolan from the southern African forms, yet they agree perfectly with Nicklés figure of *M. fulgurata*, and with specimens of *M. fulgurata* identified by Paes da Franca. For these reasons we feel that *M.* (*O.*) *fulgurata* should become a synonym of *O. variegata*, the latter apparently being the oldest valid name.

ACKNOWLEDGMENTS

We are grateful to the C.S.I.R. for a grant towards one of the S.W.A. collecting expeditions, and to the South West African Administration and the Governor of Angola for permission to collect in their territories. We are indebted to the Director of the State Museum, Windhoek, for arranging the South West Africa expeditions and for assistance with collecting, and to Mr. M. J. Penrith for providing transport and assistance for the expedition to Angola. We wish to express our thanks to Mr. R. D. Kilburn of the Natal Museum, Pietermaritzburg, for information regarding the distribution of *O. variegata* and to Mr. J. Field of the University of Cape Town for lending material.

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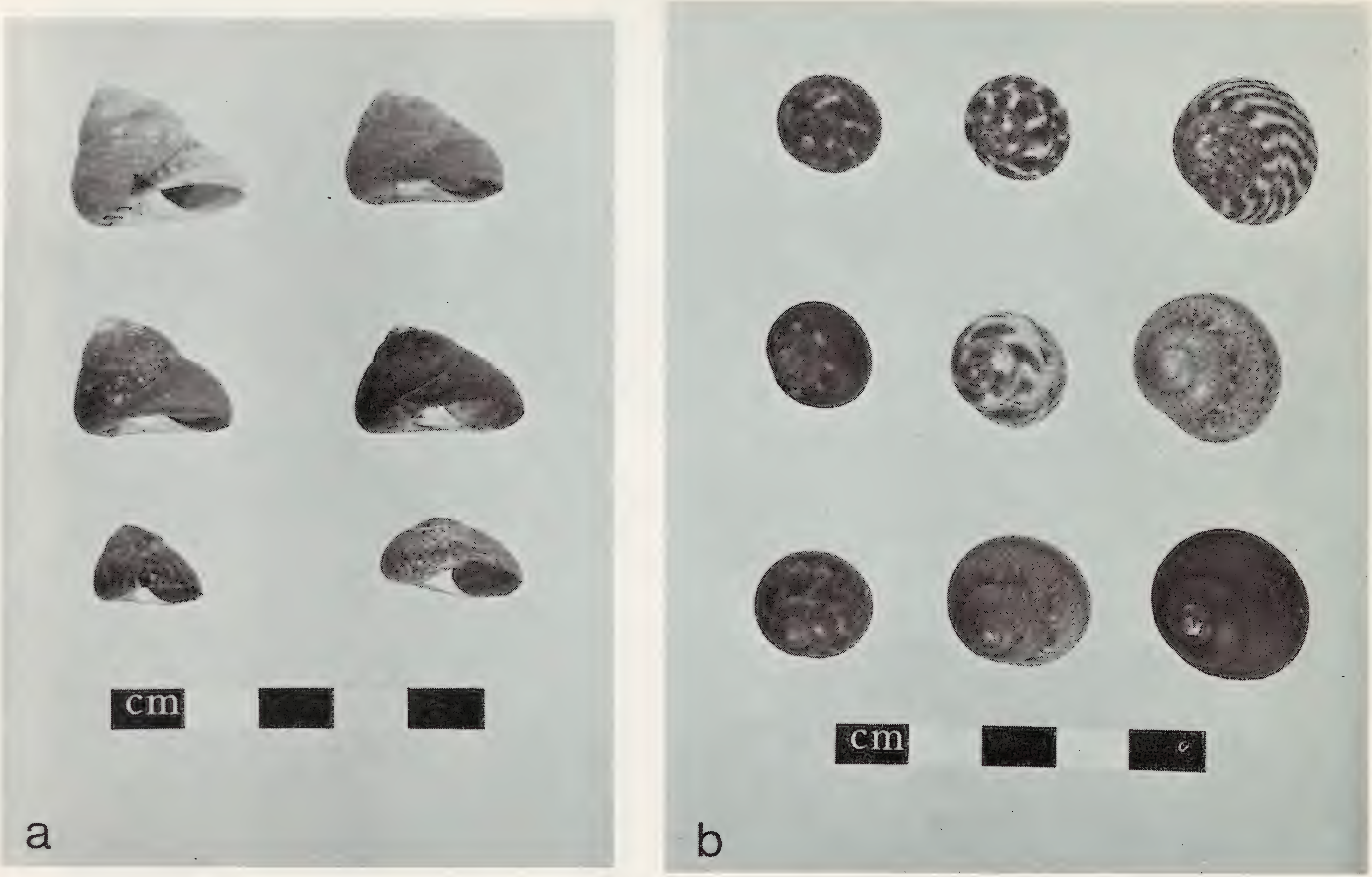
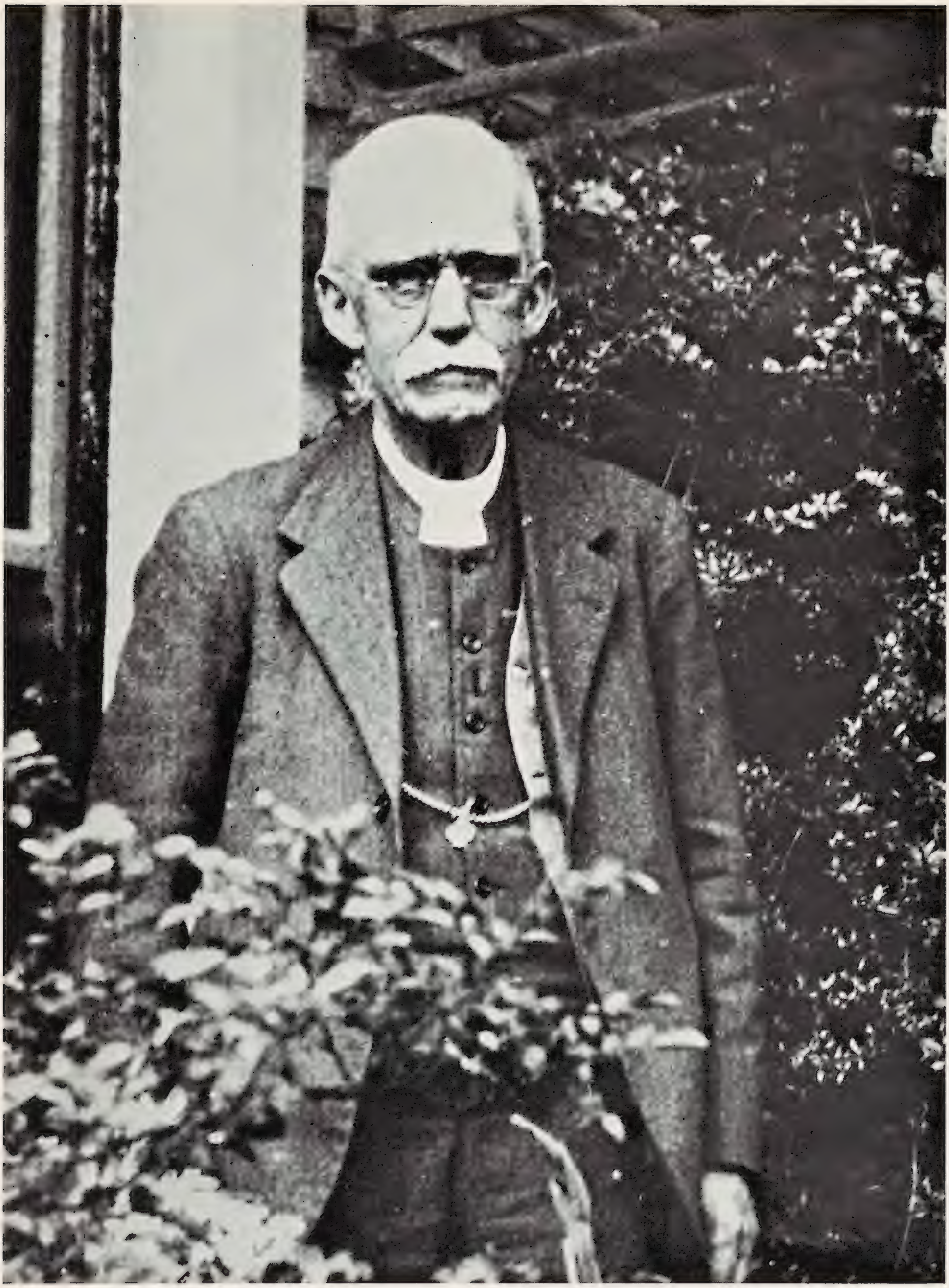
PLATE XIII



a. Variation in altitude amongst animals from the same locality (Table Bay).
b. Variation in colour pattern within the same population (Table Bay).

Plate XIV



Sincerely Yours
E. Percy Blackburn

J. Conch. **27**: 353–355 (1972)

THE REVEREND E. P. BLACKBURN AND HIS MOLLUSC COLLECTION

C. A. B. Steel

Sunderland Museum and Art Gallery

(Read before the Society, 15 May 1971)

INTRODUCTION

In 1962 Sunderland Museum acquired the mollusc collection and literature of the Rev. E. P. Blackburn. On searching for biographical material it became obvious that although a member of the Conchological Society for many years, his passing had gone unremarked. In order therefore to correct this omission and to publicise the fact that his very valuable collection has found a permanent home where it is accessible to students, the following note on Blackburn and his collection has been prepared.

THE REV. EDWARD PERCY BLACKBURN—A SHORT BIOGRAPHY

The Rev. E. P. Blackburn was born on 9 September 1862 at Bank House, Horsforth, near Leeds, Yorkshire, and after attending Bradford Grammar School joined the family firm of accountants. Rapidly becoming dissatisfied with this line of employment he entered Didsbury College to train for Methodist Ministry Missionary work. On completion of his studies in 1886 he went to India as a missionary to Trichinopoly, near Madras. His career in India was relatively short lived, for in 1889 he returned home a very sick man, forbidden by the authorities to return due to the precarious state of his health. In 1890 he married Juliet V. Bever, to whom he was previously attached, and it was largely through her care and attention that he was nursed back to health.

On completing his convalescence, Blackburn as a Wesleyan Methodist minister moved at regular intervals round the country, working in 13 different circuits as far apart as Gloucester and Blyth, Haltwhistle and Broadstairs. During his illness he became interested in Mollusca, and his early material covers most of the British Isles. He did not confine his collection to the British Isles but, by pressing his family and friends into service, was able to get specimens from all over Europe, and from the rest of the world by means of contacts with missionaries in far-flung parts of the British Empire. Rapidly however he became more and more deeply involved and more and more scientific in his approach to the subject. Whilst living in Yorkshire he came under the influence of J. W. Taylor, who perhaps stimulated the production of his magnum opus (Ref. 2).

In 1922 Blackburn was appointed minister at Haltwhistle, Northumberland, and became known in the area for his interest in conchology. On retirement in

1929, his life entered a new phase, for he was able to devote all his energies to natural history. Blackburn came to live in Newcastle and in rapid succession joined the Wallis Club, the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne and the Northern Naturalists Union. He gave active and regular support to all these organisations and rapidly rose to office, becoming Field President of the Natural History Society and then serving on the council. In 1933 he became secretary of the Wallis Club, a position that he held until his death on 26 November 1940.

During his retirement Blackburn devoted much energy to conchology and drew around him a group of people, fired by his enthusiasm. All the work carried out in this period was channelled into studying the local Mollusca, mainly concentrating on their distribution, but he also made copious notes on ecology, reproduction and taxonomy. This work culminated in the publication of his "A survey of the land and freshwater Mollusca of Northumberland and Durham" (Ref. 2) in 1934. After this publication Blackburn continued to add to our knowledge of the local molluscan fauna, but also concentrated on the Clausiliidae, a group in which he had always had a special interest, and in 1941 there was published (posthumously) "Distribution of *Clausilia cravenensis* Taylor (*suttoni* Westerlund) in Britain" (Ref. 3), a fitting end to his 43 years' membership of the Conchological Society.

Blackburn was in close contact with many notable naturalists both here and on the Continent. A. E. Boycott, Hans Schlesch, Professor Th. Schmierer, Hugh Watson, Dr. Marie V. Lebour and Dr. A. Raistrick, can be numbered amongst his associates. Blackburn paid great attention to detail in his work and his field notes and other unpublished writings show that he was continually trying to interpret molluscan faunas on an ecological basis, and as such was one of the first conchologists to attempt this line of approach.

THE BLACKBURN COLLECTION

The Blackburn Collection of land and freshwater Mollusca was given to Sunderland Museum in 1962. The bulk of the collection consisted of material from the counties of Northumberland and Durham, but also included was a certain amount of material from elsewhere in the British Isles (East Yorkshire, Gloucestershire and Scotland being the best represented areas) and a number of foreign specimens.

On sorting the collection, material from East Yorkshire, Gloucestershire and Scotland was sent to Hull Museum, Gloucester Museum and the Royal Scottish Museum respectively. The foreign material was catalogued under broad headings and stored separately from the main collection, since it is somewhat patchy and of dubious scientific value.

Accompanying the collection was a large amount of literature, mostly in the form of notebooks of various kinds relating to the collection, but also concerning more general aspects of conchology.

The local (Northumberland and Durham) material was then sorted into species, each locality group being given a separate container, and then into numerical order using Kennard and Woodward's *List* (1914) as a basis.

As mentioned in the biographical note, Blackburn was a thorough collector, and it is perhaps for this reason that his collection is so valuable. Though the collection is not remarkable for its rarities it is a complete collection. During his years in retirement Blackburn travelled all over the two counties, collecting in a manner that would be viewed with concern in these conservation-conscious days. For any given locality in Northumberland and Durham it is possible to reconstruct its molluscan fauna using either the collection or his copious field notes. Not only did Blackburn collect every species from a locality, but seemed to collect every specimen, realising perhaps that a few of the better specimens of a species do not accurately reflect the conditions in a locality. For instance, there are no less than 182 locality/groups for *Cochlicopa lubrica* (Müller) *agg.* in the collection.

The collection also includes sets of specimens sent to Blackburn by various authorities for use as typical specimens, and a certain amount of British marine material, most of this latter being without adequate data.

Included with the British material is a series of Clausiliidae from all over the world: as mentioned previously these were one of Blackburn's special interests, and it was felt that it would be appropriate to leave these as one unit with the main collection.

Most of the Northumberland and Durham material dates from 1930–34, the period when his 1934 paper was in preparation. The literature includes correspondence with people like Boycott, Schmierer and local conchologists. One item is of particular interest, and this is his Molluscan Place Names, in which are compiled all the available records for Northumberland and Durham. These records are grouped according to their division of the vice-county and the period of time when the record was taken. Also to be found in the literature are several unpublished papers and work concerning the status of the Clausiliidae in the north of England.

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J. Conch. **27**: 356 (1972)

REVIEWS

Seashells how to identify and collect them. With an introduction by Michael Tweedie. Pp. 1–16, pls. 149 in colour. Orbis Books, London 1971. (distributed by The Bodley Head, 9 Bow St., London WC2.) Price £1.25 net (in U.K. only).

This lovely book is a translation from the Italian *Conchiglie da Collezione* by Sergeio Angeletti, and the magnificent colour photographs by Carlo Bevilacqua have been reproduced perfectly. In fact, to quote from a review of the Italian original "the illustrations in this book are among the finest pictures of shells which have ever been published".

The English version, however, is more than a straight translation: some text-figures have been added, some omitted, and a glossary added. The reviewer does not, unfortunately, read Italian, but a comparison of the two books suggests that the Italian text has been freely adapted: the result makes quite interesting background reading for the superb illustrations which, after all, are the purpose of the book. Despite the title it is not a collector's guide to identification at all, but a collection of beautiful shell-studies with careful notes on the distribution of the species illustrated.

The spelling errors noted in the Italian original have been rectified, but it is a pity that no list of the plates is given. It would have been a useful feature.

The cost is astonishingly low—£1.25—and everyone who admires beautiful shells is urged to acquire a copy of this book forthwith.

Nora F. McMillan

Oceanography, by M. Grant Gross. 2nd. edition, 1971. Charles E. Merrill. Pp. 1–150. (Distributed in the U.K. by Prentice-Hall International). Price £1 (paperback).

This useful work, now brought up-to-date, is one of the Merrill Physical Science series, and is (as was the 1st. edition of 1967) planned for a short University course. The emphasis throughout is on physical, rather than biological, oceanography, and in its 150 pages the book gives much valuable information.

The first edition was reviewed in this *Journal* (vol. 26, p. 339) and that reviewer's approving remarks are equally applicable to the present edition.

Nora F. McMillan

J. Conch. **27**: 357–358 (1972)

THE COOK VOYAGES AND CONCHOLOGY: A SUPPLEMENTARY NOTE

S. Peter Dance

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(*Read before the Society* 16 *October* 1971)

In my recent paper "The Cook voyages and conchology" (Dance, 1971) I said that no information about the shells collected between 1768 and 1780 was published until 1778. In that year an article on shells of the "South Land" was published by F. A. Zorn von Plobsheim (1778). As the first voyage was completed in 1771 I was surprised that seven years had elapsed before anything on the shells collected by Cook's men was published. A study of *Der Naturforscher*, a contemporary periodical, has proved that at least three articles were published before 1778.

The first of these, by Johann Ernst Immanuel Walch (1725–78), appeared in 1774 and discussed some shells in the collection of Friedrich Carls of Schwarzburg-Rudolstadt (Walch, 1774). This gentleman (he was heir-presumptive to a princely title) had a fine collection which was described and illustrated subsequently in a book by Christoph Ludwig Kämmerer (1786). He had received the shells from a London dealer named "Forster" who had acquired them from "Banks und Solander". This dealer is probably the same man who sold specimens to Henry Seymer obtained during the second Cook voyage; his real name was Foster (Dance, 1966 : 108–9). The shells, presumably all from the first voyage, were said to have come from various places, e.g. South America, Falkland Islands, etc. One of the species illustrated is a species of *Oleacina*, a land-pulmonate genus found in South and Central America. Another is *Clithon corona* (L.), a species found in the Philippines and other parts of the Pacific Ocean. Another illustration appears to represent *Cantharidus purpurea* (Gmelin) a species known only from New Zealand. This, then, is the first paper to describe and illustrate shells collected during the Cook voyages. It contains what appears to be the earliest published illustration of a species from New Zealand.

In the following year F. A. Zorn von Plobsheim published an illustrated article on some shells in the collection of the Literary and Philosophical Society of Danzig (Zorn, 1775). The shells had been acquired, directly or indirectly, from George Humphrey, the well known London dealer, and were collected during the first or second voyages. The illustrations show four species in the natural state and polished. Easily identified is *Lunella smaragda* (Gmelin), a familiar New Zealand species.

This article was followed, in 1776, by one written by Lorenz Spengler (1776).

Again the shells dealt with were from Humphrey and all of them, we are told, came from the *Resolution*, Cook's ship during the second and third voyages (the date makes it certain that these shells were all collected during the second voyage). Among the species illustrated are *Cookia sulcata* (Gmelin) and *Maurea punctulata* (Martyn) from New Zealand, and *Pyrazus ebeninus* (Bruguière) from Australia (the other shells illustrated, two species of *Crucibulum* and a *Haliotis*, are not identifiable with certainty). Consequently, the first recognisable illustration of a characteristically Australian species is to be found in this article. Anyone wishing to look further into the historical aspects of New Zealand and Australian conchology should pay particular attention to the articles on "South Sea" shells published in *Der Naturforscher* between 1774 and 1783.

I should like to correct a small error in connection with another part of my paper. I said that the copy of Thomas Martyn's *The Universal Conchologist* now in the New York Public Library once belonged to P. Dautzenberg (Dance, 1971 : 372 footnote). This cannot be true as Dautzenberg's copy is in the Royal Institute of Natural Sciences of Belgium in Brussels. In his paper on *The Universal Conchologist* Dautzenberg (1917) reproduced a letter of Martyn's which was inserted in his copy of the book. Mr. Mart Hulswit of New York recently drew my attention to the copy of *The Universal Conchologist* in the New York Public Library in which an *apparently identical* letter is inserted! I concluded, perhaps not unreasonably, that Dautzenberg's copy had been acquired by that library. Preliminary investigations by Mr. Hulswit indicate that there may be still other copies of the book in which similar "Martyn" letters may be found. Information on any such copies would be welcomed.

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J. Conch. **27**: 359–361 (1972)

THE BRITISH DISTRIBUTION OF *POMATIAS ELEGANS* (MÜLLER)

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(*Read before the Society, 16 January 1971*)

Pomatias elegans (Müller) is our clearest example of a calcicole land mollusc, requiring, according to Boycott (1934), at least 5 per cent. of free calcium carbonate in the soil on which it lives. The soil must be loose and friable so that it can burrow. Rubbly limestone banks are a favourite habitat. It likes a certain amount of scrubby cover, but avoids both thick woodland and open ground. A general account of its biology is given by Kilian (1951).

The accompanying map (Figure 1) brings together all available information on the distribution of *P. elegans* in the British Isles. Three classes of 10-kilometre square records are distinguished: (a) living post-1950 (the great majority are post-1960), (b) pre-1950 only, and (c) Postglacial fossils. In practice it has sometimes been difficult to decide to which class a particular record should be assigned. The reason is that *P. elegans* has a thick resistant shell, and empty examples picked up on the surface (unless obviously fresh) offer no proof that the species continues to live in the area. I have treated such finds with caution. For example, shells are common in Whitlingham Woods near Norwich (63/272078); the habitat seems ideal (chalky broken ground with *Mercurialis* under thin open woodland) but after a long search in April 1970 I failed to detect even a single living example, and the record has therefore been placed in the "pre-1950" class. In some instances records placed in this category should probably more correctly be regarded as fossil. Many of the nineteenth century Lincolnshire records are based on odd dead shells picked up in chalk pits and such-like places where derivation from Postglacial hillwashes is likely, and the species has in fact been observed living with certainty in the county in only two localities (Burwell Wood (53/38); Welton-le-Marsh (53/46)).

P. elegans is fairly common in southernmost England and Wales, and, as its ecology might suggest, its distribution reflects with some precision the outcrops of chalk or limestone within this area. In East Anglia it lives also on chalky boulder clay, and in north Devon and Cornwall on calcareous shell sand. In northern England it becomes rare, although it is interesting to discover that the colonies at Burwell in Lincolnshire (53/38) and Oglethorpe in Yorkshire (44/44) were already known to Martin Lister, nearly three centuries ago (Lister, 1678: 120), and a still-existing colony in an old limestone quarry at Wakerley in Northamptonshire (42/958990) is referred to by Morton (1712: 414).

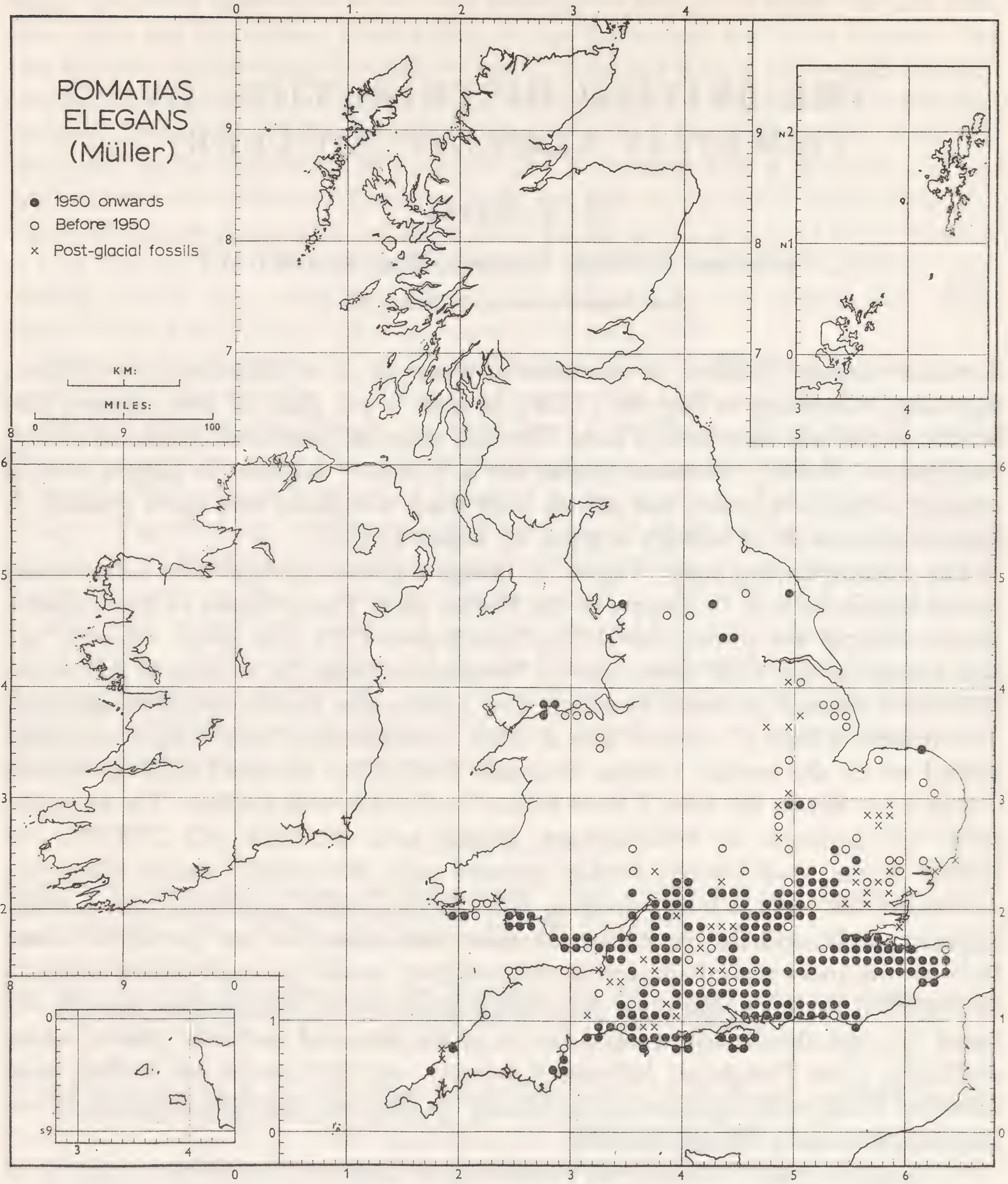
POMATIAS
ELEGANS
(Müller)
● 1950 onwards
○ Before 1950
× Post-glacial fossils
KM:
MILES:
0
9
100
0
1
2
3
4
5
6
7
8
9
N1
N2
s9

Fig. 1.

P. elegans is a southern European (Mediterranean) species. It may well be frost-sensitive, since the main area of its distribution in Europe is rather closely bounded by the January isotherm for about +2°C. I have elsewhere argued (Kerney, 1968) that the lowering of winter temperatures since the thermal optimum of the Postglacial (i.e., after about 3,000 B.C.) may have brought about a contraction in range. According to this idea, the widely scattered colonies in Denmark, central Germany, Austria and Hungary represent survivals from a more general north-easterly distribution in localities happening to possess favourable microclimates.

The British distribution (Figure 1) shows evidence of a shrinkage. This is particularly noticeable in the east Midlands, East Anglia and Lincolnshire, and may not be unconnected with the fact that this is an area of rather cold winters with average daily minimum temperatures for February below +1°C. (i.e., colder than any part of the British Isles south of Northumberland and Durham). It is suggestive that *P. elegans* is now rare along the chalk escarpment north of Hertfordshire, in contrast with its continuing abundance further to the south-west where frosts are fewer. Unfortunately, a distribution map such as Figure 1 can only help us to frame hypotheses, but not to decide upon their validity; no precise experimental work has yet been done on the thermal tolerances of *P. elegans*, nor have studies been made of the microclimates of places where it lives and does not live.

Although the decline of *P. elegans* may have its origin in a long-continued thermal change, human pressures have undoubtedly accelerated it. The species survives well in hilly areas with steep slopes or natural rock outcrops, but in flatter country, where modern agricultural methods tend to eliminate the scrubby hedgebanks and bits of waste ground that the species likes, the decline is noticeable. In parts of Wiltshire it is becoming quite scarce. In Essex many localities have been destroyed by ploughing. For example, the isolated colony described by French (1890) living on chalky boulder clay at Felstead (52/673223) is now extinct. The habitat was a small spring-hollow on the margin of a river floodplain, but by 1967 this had been smoothly ploughed over, and a few dead shells in the field are all that remain to indicate its former presence. The species now hardly occurs in Essex, and further east, in Suffolk, no living colony has been described since 1909.

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J. Conch. **27**: 362 (1972)

REVIEW

De Landslakken van Nederland. E. Gittenberger, W. Backhuys, Th. E. J. Ripken. Amsterdam: Koninklijke Nederlandse Natuurhistorische Vereniging, 1970, pp. 177, 192 figs., 87 maps. n.p. [fl. 16].

This attractively produced work is a manual for the identification of the species of land Mollusca living in the Netherlands. All the species are illustrated by line drawings of the shells (or of the external appearance of slugs), and many details of internal anatomy are also given. As the greatest part of the fauna is also British, the book should prove of value to workers in this country. The drawings are uniformly of a very high standard. Many are reprinted from Dr. W. Adam's book on Belgian molluscs (Mollusques terrestres et dulcicoles, *Faune de Belgique*. Brussels, 1960), but a considerable number are original. Particularly noteworthy are the beautiful drawings of the segregates of *Carychium*, *Columella* and *Cochlicopa*. The drawings of Zonitidae are also very good, and bring out well without exaggeration the specific characters in this rather difficult group.

In Figure 108 (*Milax gagates*) the internal shell illustrated is not that of a *Milax*, but of a *Limax*.

Unfortunately it is not easy to judge of a text written in Dutch, but the approach appears to be both up-to-date and critical. Further references are given throughout, especially in the case of controversial taxa (e.g., *Cochlicopa*, *Truncatellina*, *Arion circumscriptus/silvaticus*). Brief descriptions are also included of species that might be expected to occur in the Netherlands (e.g., *Boettgerilla vermiformis*).

A special feature of the book is the series of distribution maps, compiled largely from published information and museum material. It is perhaps a pity that their are "locality dot maps" rather than grid maps, since it is very hard to obtain an even and impartial coverage by this method, and the control map (Figure 87) shows that there is in fact a heavy bias in the dots towards Limburg and the coastal region. Nevertheless, there are few European countries for which such a useful and detailed set of maps is available. It is interesting to observe the restriction of many calcicole species (e.g., *Pomatias elegans*) to Limburg, a region where central European elements also make their appearance (*Orcula doliolum*, *Clausilia lineolata*, *Fruticicola fruticum*). Other surprises are the very different distributions of the species of *Helicella*, and of the way in which *Clausilia dubia* and *Hygromia rubiginosa* are virtually restricted to river valleys. This is a valuable contribution towards the hoped-for eventual compilation of general European distribution maps.

M. P. Kerney

J. Conch. 27: 363–369 (1972)

THE DISTRIBUTION OF *HELICODONTA OBVOLUTA* (MÜLL) IN BRITAIN

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(*Read before the Society, 15 May 1971*)

INTRODUCTION

Helicodonta obvoluta (Müll) is one of the rarest species of land snail native to Britain, being restricted to a small part of West Sussex and Hampshire. The last full accounts of its distribution in Britain were published over 50 years ago (Taylor, 1916; Beeston, 1919). At that time, it was largely restricted to calcareous woodlands. The species was found on the South Downs from Amberley in the east to Buriton in the west (Figure 1), with outlying populations near Petersfield, Alresford and at Crabbe Wood near Winchester. Dead shells, presumably subfossil, have been found on the North Downs, especially near Mickleham in Surrey (Davis, 1952). Many of the records reported by Taylor and Beeston have been unconfirmed since the nineteenth century, and since there has been much disturbance of the species' habitat since then, it seems worthwhile to assess the present distribution of the species.

THE PRESENT DISTRIBUTION

In the course of studying the distribution of Mollusca in woodland on the South Downs, I have discovered populations of *H. obvoluta* in some of the sites investigated. In addition to my own records, I have been given unpublished records belonging to M. Goodchild and the late H. Dixon Hewitt, A. E. Ellis and P. T. Wimbleton. All these records are *post* 1947, and most are *post* 1960. Published records of *H. obvoluta* in recent years comes from Langmead (1943), and Dance (1958). Full details of all unpublished records have been deposited with the Non-Marine Recorder (Dr. M. P. Kerney).

Figure 1 shows the distribution of *H. obvoluta* at the present time, based on all records subsequent to that of Langmead (1943). Also included are my own negative records, each of which represents an hour's search over an area of c. 1,000 m^2. There are no recent records for either Crabbe Wood, Winchester (before 1885; searched several times in recent years without success (M. P. Kerney, personal communication)), or Alresford (last confirmed before 1858), and these areas are not shown on the map.

Most of the recent finds are of living specimens, or of fresh dead shells with

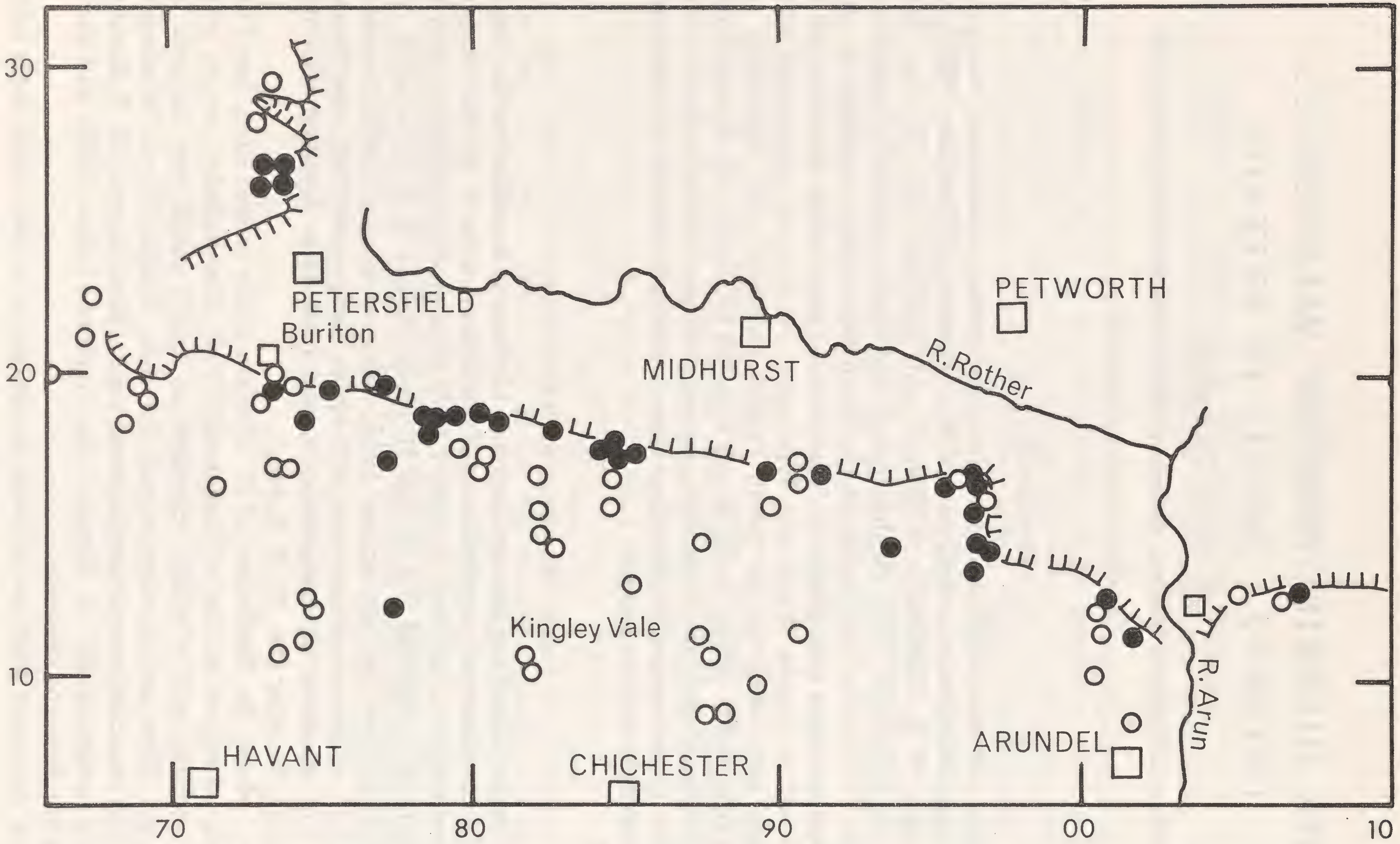

Fig. 1. The distribution of *H. obvoluta*. ● = Recent records (post 1947) of *H. obvoluta*. ○= negative records (R.A.D.C. only). ⊥⊥⊥ = Scarps. The 10 km grid of the Ordnance Survey is shown in the margins.

periostracum intact. One sample, from Kingley Vale National Nature Reserve (Grid Ref. SU 823103) consists only of very old bleached shells from hill-wash in a yew (*Taxus baccata*) wood. The habitat is unlike any from which living snails have been taken, and it seems likely that *H. obvoluta* has been extinct there for a long time.

Nearly all recent records of *H. obvoluta* are from steep scarp slopes. Taking my own records alone, 13 out of 32 scarp sites contain *H. obvoluta*, while only 2 out of 34 sites on the gentler dip slopes do so. The woods on the scarp are generally on steep slopes, with soil pH values usually greater than 7·0 and always greater than 6·0. By contrast, many woods on gentle dip slopes have soil pH in the range 5·0–6·0. Both my samples of *H. obvoluta* on dip slopes are from woods on steeper than average slopes with soil pH's of 6·5 and 7·0.

Of 34 records of *H. obvoluta*, 31 are from more or less mature woodland. Of the three records outside such woods, one of live shells, near Up Park, is from a recently felled wood (at present hazel scrub), another, of one empty shell only, is from a grassy bank overhung by beech trees, and the third comes from a quarry partly overgrown by trees. Most woodlands on the Downs are of beech (*Fagus sylvatica*) and ash (*Fraxinus excelsior*), beech being usually the commoner.

In my own samples, *H. obvoluta* tends to occur in those woods with a very rich snail-fauna—an average of 20 species being found per site. All recent observers seem to be agreed that the best microhabitat to search is rotting logs, especially old and soft ones. Woods with much fallen timber are much more likely to yield *H. obvoluta* than those with little or none, and one can often search in vain in litter close to logs in which several individuals have been found. It is not, however, confined to logs; there are some records from litter and one from the trunks of living trees. In winter, it can be found buried in the litter, the white epiphragm being very conspicuous. Beeston (1919) summarizes what is known of its habits. Specimens I have kept in the laboratory will eat, and survive on, old beech and ash leaves. Frömming (1954) lists a large number of plants eaten in captivity.

CHANGES IN DISTRIBUTION DURING THE LAST FIFTY YEARS

There have been some clear changes in distribution since the turn of the century. These are difficult to follow in detail, because the exact localities of many old records are not given, and it is thus impossible to confirm them. The peripheral population at Crabbe Wood has evidently died out; that at Alresford has not been confirmed.

The range along the scarp of the South Downs does not appear to have altered much. Only three old sites have been searched recently without success: Bury Hill (TQ 005125), which is now scrub—the felling and subsequent extinction of *H. obvoluta* were recorded by Dalgliesh (1939); Rackham Wood (TQ 049128), and Springhead (TQ 060129), both east of the river Arun in what are now very disturbed woods of rather small size. The Rackham population was first discovered by Langmead in 1943. *H. obvoluta* still occurs east of the Arun, however, in a newly-discovered site 1 km. east of Springhead.

Bignor Hill (SU 978134), another old site on the scarp, has not been confirmed recently, but *H. obvoluta* was still there in the 1930's (A. E. Ellis, personal communication). At the western end of the range, the woods above Buriton (SU 737197) now yield only dead shells, in spite of prolonged searching (P. T. Wimbleton, personal communication). Over the scarp as a whole, however, more sites are now known than previously. The small group of populations on the scarp of the Hampshire Downs north of Petersfield are still flourishing.

The situation on the dip slopes, coming down towards the sea, is less satisfactory. Beeston (1919) lists nine sites of *H. obvoluta* off the scarp. One of these, discovered by A. W. Stelfox, is just to the north of the scarp in a lane near Bignor. Subsequent searches in the area have failed to confirm the record, although the exact locality is not certain. The remaining eight records are all on the dip slopes. Two of these, at Kingley Vale, and at Woodend nearby, are almost certainly based on subfossil material only; live snails have never been found (Taylor, 1916). Another site, at Winden Wood (SU 835167) was recorded by Clement Reid, who found only bleached shells (Beeston, 1919). The habitat is described as a hazel copse, and it seems likely that the population had even then been extinct for some time. Of the remaining five sites, only one can be located accurately—Ditcham Wood (SU 743180), where P. T. Wimbleton, who was shown the site by Beeston, finds *H. obvoluta* still very abundant.

One of the remaining sites is given as "William Wood near Stoughton" by Beeston, the discovery of George Jeffry, while Taylor (1916) mentions a site "William Wood, Up Park", the discovery of the Rev. W. A. Shaw. It is not certain that these refer to the same site, and I cannot at present locate it accurately.

The three remaining sites named as Phyllis Wood, Charlton Forest and West Dean Woods, are all large areas, and it is not certain exactly where each find was made. Large parts of all these areas have been searched recently without success; like many woods on the dip slopes they have been subject to extensive felling and replanting with conifers and beech. Thus, three out of the four recent records from the dip slopes are new—and only one old record from there (Ditcham Wood) has been confirmed.

Although only five sites on the dip slopes recorded by Beeston had living *H. obvoluta* in them, he says, refuting the idea of earlier writers that it occurred predominantly or exclusively on the scarp, "This is not so, as it is abundant on the southern side, and more plentiful and of larger size than on the northern slopes." It is not clear from Beeston's paper how many of the sites he visited, and it is tempting to think that this remark was based more on his knowledge of Ditcham, which still supports the densest populations, than on the south slopes in general. His statement is certainly not true in general terms today, and several populations on the dip slopes have clearly become extinct due to felling and other human disturbance.

In Beeston's time, *H. obvoluta* was evidently a common snail, at least at Ditcham (where 100 could be collected in an hour!), and he reports it commoner than *Hygromia striolata* (C. Pfeiff.), and of roughly equal abundance with *Clausilia bidentata* (Ström) and *Marpessa laminata* (Mont.). An earlier record from Harting Woods (Weaver in Gordon, 1877), indicates that 30 or 40 specimens could be collected there in an hour. With the possible exception of Ditcham, present-day populations are not as dense as these figures suggest, although the species is still comparatively easy to find at Harting. It is certainly not as common as *H. striolata* or *M. laminata,* but it is much easier to find than some other large snails such as *Helicigona lapicida* and *Arianta abustorum* L., both of which are very rare on the downs.

FACTORS AFFECTING THE DISTRIBUTION OF *H. OBVOLUTA*

H. obvoluta in Britain is at the north-west limit of its range (Taylor, 1916). Its post-glacial distribution in Britain was wider than at present, there being records from Surrey, Wiltshire, Dorset and Gloucestershire (M. P. Kerney, personal communication). Some of these finds probably date from the post-glacial climatic optimum, since when not only has the climate deteriorated, but there has also been extensive human alteration of habitats.

Where *H. obvoluta* is on the edge of its range, it seems to be restricted to woodland, especially calcareous woodland. It is a woodland species at high altitudes in the Geneva district (Favre, 1927), as it is on the alpine slopes of northern Italy (Girod, 1968), where felling and human activity affect it adversely. It is more or less restricted to calcareous woodlands in the high valleys of the Pyrenees (Cameron, unpublished). The northernmost populations in Germany are in woodland (Schlesh, 1934). In the centre of its range it is more catholic in habitat, and may be found in hedgerows and scrub as well, with less dependence on lime (M. P. Kerney, personal communication; Germain, 1930). The restricted habitat of the species in Britain is thus not surprising.

It is hard to explain the present very limited distribution in Britain on grounds of habitat alone. The woods of the South Downs, which it frequents, are not very different from those of other areas of chalk downs, especially those on the Chiltern Hills and the North Downs, both of which are well-wooded. Recent evidence suggests that none of these woods, with dominants of beech and ash rather than oak, are primaeval (Pennington, 1969). Although some woods on the South Downs contain such "Anthropophobes" as *Limax cinereoniger* Wolf, *Acicula fusca* (Mont.) and *Hygromia subrufescens* (Miller) (Boycott, 1934), there is no doubt that all the present woods are the products of human management, and many of them, even on the scarp, are the result of plantation in the eighteenth century (Brown, 1953). Several of my samples from scarp woodlands contain very old bleached shells of such typical grassland species as *Helicella itala* (L), *H. caperata* (Mont.), *Vallonia excentrica* Sterki, and *V. costata* (Müll), indicating that these sites were at one time unwooded, since I have never found fresh or living specimens of these species in these woods.

Although there is some evidence of climatic differences between the South Downs and other areas of down land sufficient to cause differences in the abundance of some molluscs (Cameron and Palles-Clark, 1971), the area at present occupied by *H. obvoluta* does not seem very distinct climatically from other areas of downland without the species.

Almost certainly, further searches will reveal new populations of *H. obvoluta* within the area of its present range, and possibly outside it. The range, however, has contracted substantially since the climatic optimum, and appreciably in the last 50–70 years. In all cases where recent searches have failed to confirm old records, there is evidence of human disturbance of the site, usually by felling. Undisturbed sites with mature trees and plenty of fallen timber do not appear to have suffered, although there may have been some reduction in density. The only exception is Buriton Woods, where dead shells only can be found; many of the trees in this wood are diseased, and seem unlikely to survive for long (P. T. Wimbleton, personal communication).

Although it is clear that, in the past, *H. obvoluta* could either survive the felling of woods, or was available elsewhere for recolonisation when the wood regenerated, there can be little doubt that it is human disturbance rather than adverse climate which constitutes the biggest risk to the species' short-term survival in Britain. Fortunately, although felling continues in some areas, many sites are now in the custody of the Sussex Naturalists' Trust, and steps are being taken to conserve the habitat (D. T. Streeter, personal communication).

ACKNOWLEDGMENTS

Less than half the records of *H. obvoluta* on which this paper is based are my own, and Mr. M. Goodchild and Mr. P. T. Wimbleton in particular have supplied me with records and information about the district. Miss J. E. Chatfield, Mr. A. E. Ellis, Dr. M. P. Kerney and Mr. A. W. Stelfox have all generously helped me with information, and Dr. Kerney read a draft of the paper. Dr. D. T. Streeter, for the Sussex Naturalists Trust, has told me of their plans and reserves in the area. I am indebted to the Nature Conservancy and the Goodwood Estate Company for permission to collect on their land. I should like to thank Miss J. Switzer for facilities at Portsmouth Polytechnic.

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J. Conch. **27**: 370 (1972)

REVIEW

Seashore life in Cornwall and the Isles of Scilly, by Stella M. Turk, with line drawings by R. D. Penhallurick. Pp. 1–124. D. Bradford Barton Ltd., Truro. 1971. Price £1.40.

The number of books dealing with seashore life generally is large, but those dealing with the littoral fauna and flora of a single area are uncommon. The 250 miles of Cornish coastline, the farthest south-west part of England, possess a rich and varied fauna and flora and Mrs. Turk has produced an attractive volume to act as a general guide to these prolific shores.

The book begins with an account of the types of shore with a most useful map showing their Cornish distribution. Next comes a chapter on plankton, not perhaps very relevant in a book on shore life but no doubt included because of the planktonic stage of many littoral animals. Chapters on algae and various invertebrate phyla follow. Mollusca are treated of on pp. 61–65, and nineteen species are well figured. Unfortunately Mrs. Turk has throughout omitted authorities for the species mentioned. This was presumably done in order to make the book more acceptable ("easier"?) to beginners, but it is a pity that the full names of the species are not given, even in an appendix. The book only contains 115 pages of text; this includes 11 pages of line-drawings and two excellent indexes, one of species, the other of places mentioned, so surely room could have been found for a list of species *with* authorities? Sooner or later beginners have to cope with full scientific names after all!

Chapter eleven gives a useful list of books on marine life, and a short historical survey of marine biology in Cornwall. This is excellently done; it is curious that the north coast of Cornwall has been so little studied, judging by the papers listed.

The book is beautifully produced, the "tail-pieces" at the end of each chapter are delightful, and a number of plates illustrate various collecting grounds. It can be warmly recommended as a good "first book" for those who are just becoming aware of the richness of seashore life, particularly in the far south-west.

Nora F. McMillan

J. Conch. 27: 371–372 (1972)

TWO SPECIES OF GASTROPOD MOLLUSCA NEW TO THE IRISH FAUNA

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(*Read before the Society*, 16 *October* 1971)

Mr. Michael Long of Dingle, Co. Kerry, has brought to my notice, three very interesting Mollusca found off the Co. Kerry coast. The shell of *Ranella olearium* (L.) was trawled west of the New Ground in 50 fathoms during the first week of May, 1968. The specimen was well worn and covered by marine growths, indicating that the animal had evidently died long before capture. The lower margin of the shell's siphonal canal was slightly damaged, thus shortening its height, which is now 124mm., its breadth being 70mm. This specimen is thus larger than those mentioned in Massy (1930) and McMillan (1968). Mr. Long informs me that he has a fragment of the same species in his collection which was taken on the same ground in 1964. He has generously presented the whole specimen to the National Museum, its register number is NMI 40. 1968. *R. olearium* is synonymous with *Ranella gigantea* Lamark, *Gyrina gigantea* (Lamark), and Massy (1930) employs the synonym *Bursa gigantea* (Lam.) var. *atlantica* Monterosato.

It would appear that Mr. Long's specimens are the first recorded for Ireland within the 100 fathom line. Massy (1930) records one specimen taken at 152 fathoms in 1911 by the Fisheries Branch "Helga" at 51° 21′N, 11° 24′W. Standen (1915) exhibited five specimens "dredged alive recently off the south-west coast of Ireland in deep water". McMillan (1968) notes that several living specimens have been dredged in 50 to 100 fathoms between St. David's Head and Carnsore Point.

This species is widely distributed in the Mediterranean, and occurs in the Azores, Canaries, and north-east Atlantic reaching its northern limit off S.W. Ireland. Mr. Long's specimens must, therefore, be among the most northerly of those found in the eastern Atlantic to date. McMillan (*pers. comm.*) informs me that this species also occurs off Angola, Natal, New South Wales and New Zealand.

Two live specimens of *Charonia lampas* (L.), also known under the synonym *Triton nodiferus* Lam., were also presented to the National Museum by Mr. Long. One specimen, reg. no. NMI 3. 1970, had both ends slightly damaged and the rib forming the margin of the lip had broken off. Its measurements are H. 125mm., B. 63mm., no allowance being made for the damage. This specimen was taken by M. T. *Guiding Star*, Mr. Patrick Flannery, Skipper, between Sybil Head and Inishtooskert in 50 fathoms on 8 April 1970. The second specimen, reg. no. NMI

13. 1971, was taken just south of the Great Blasket on 8 June 1971, and was presented by the crew of the M.T. *Morning Star*, Mr. Joseph Walsh, Skipper, per Mr. Michael Long. Approximately 30 mm. of the apex of the shell is missing, and its present measurements are: H. 145mm., B. 73 mm. Its original height may therefore have been in the region of 175mm. *C. lampas* is distributed in the Mediterranean, and eastern Atlantic from Senegal northwards to Biscay. However, some three or four living specimens were trawled off the coast of Guernsey between 1825 and 1847 (Crowley, 1961). This species has not been previously recorded from Irish waters, and Massy (1930) does not list its occurrence in the deeper waters off the coast of Ireland. Crowley (1961) gives the lengths of the Guernsey specimens as follows: 136mm.; over 10 inches (254mm.); over 8 inches (203mm.) and nine inches (229mm.). Mr. Long's specimens are, therefore, smaller than three of the Guernsey shells.

Apart from the extreme rarity of this species in British and Irish waters, it appears likely that its occurrence off the Co. Kerry coast constitutes the most northerly record of its distribution in the eastern Atlantic.

ACKNOWLEDGMENTS

Mr. Michael Long, and the crews of the Dingle trawlers *Guiding Star* and *Morning Star* are to be congratulated on the discovery of these shells. I am indebted to Mrs. N. F. McMillan, City of Liverpool Museums, for confirming identification of these specimens.

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POSTSCRIPT

Since the above note was written Mr. Long has presented two further live specimens of *Charonia lampas* to the National Museum of Ireland. The first specimen, reg. no. NMI 36.1971, was taken by the "Morning Star" on 15 November 1971, while trawling 9 miles SW. of the Great Blasket in 50 fathoms on a muddy bottom. Its measurements are as follows: H. 97 mm. B. 58 mm. The second specimen and indeed the largest, reg. no. NMI 37.1971, was taken by the "Maov. Dearca" on 16 November 1971 while trawling on the "Wild Bank" some 3 miles S. of Slea Head on a bottom of coarse sand.

J. Conch. 27: 373–375 (1972)

ON THE NOMENCLATURE OF THE COMMON DOG-WHELK

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(*Read before the Society*, 16 *October* 1971)

There has been considerable confusion over the correct nomenclature of the Common Dog-Whelk, named *Buccinum lapillus* by Linnaeus (1758), which has been referred to *Nucella*, *Polytropa*, *Purpura*, and *Thais* by various authors since the war. Some writers seem to switch from one name to another quite arbitrarily, using different names in successive papers. Rehder (1962) clarified the situation but does not appear to have been widely read in this country. Much of the trouble arises from the great variability of the species over its wide geographical range —which includes part of the American east coast as well as the whole European Atlantic seaboard. Earlier authors described varieties as separate species and, where varieties do not occur in the localities (or collections) of later writers, confusions have arisen over synonomy. Added to this, field biologists are very conservative on nomenclatural matters and resist change for years.

PURPURA Bruguière (1789)

Buccinum L. has been split into a number of genera by subsequent workers and Bruguière (1789) used the name *Purpura* for one of his four divisions—with *B. persicum* L. as first-mentioned species. The word Purpura was in use before the Linnaean system of nomenclature came into general use but Winckworth (1945) considered this rather brief reference to be the first valid use of the name to define a genus by reference to a type species. Bruguière does not appear to have included *B. lapillus* L. in his division *Purpura*, but Lamarck (1822) expanded the genus to some 50 species, retaining *B. periscum* L. as type; and did include *B. lapillus* L. along with two other "species" now considered varieties of *lapillus*. Nearly all nineteenth century writers refer to the Common Dog-Whelk as *Purpura lapillus* (L.) but the genus has since been re-defined and the name *Purpura* Brugiuère (1789) is used in a more restricted sense (Winckworth, 1945; Clench, 1947) for Linnaeus' *Buccinum persicum, B. patulum* etc.

POLYTROPA Swainson (1840)

This is the only name unequivocably applicable to *Buccinum lapillus* L., but it must inevitably yield precedence to one of the older names if they can be shown to be valid. This does not necessarily preclude its use for defining a subgenus and it has been used in this manner by Adams & Adams (1858) under *Purpura*, and by Clench (1947) under *Thais*.

THAIS Röding (1798)

Thais and *Nucella* were both introduced in 1798 by Röding (sometimes spelt Roeding) in his revision of Bolten's "Museum Boltenianum". Both names appear to have been generally overlooked until Dall (1906) drew attention to Röding's work. However *Nucella lapillus* Röding is not at all synonymous with *B. lapillus* L. and indeed this latter species is not mentioned as a synonym under any of Röding's species. Several workers have accordingly considered the name *Nucella* Röding to be inapplicable to the Common Dog-Whelk which they refer to as *Thais* Röding. Clench (1947) summarises this argument. If correct, the name *Nucella* is not available to define a sub-genus either and hence Clench considers Dall (1909) to have been mistaken in using it as a sub-genus of *Thais* for *lapillus* (L.), and he himself chose *Polytropa* Swainson as the next available name.

Advocates of *Thais* thus officially refer to the species as *Thais* (*Polytropa*) *lapillus* (L.) although Clench added that *Polytropa* should "in all probability be raised to a full genus".

NUCELLA Röding (1798)

In his List of British Marine Mollusca Winckworth (1932) indicated that *Nucella theobroma* Röding was synonymous with *Buccinum lapillus* L. and thus included the Common Dog-Whelk in that list as *Nucella lapillus* (L.). Clench (loc. cit.) was unable to substantiate this synonomy and rejected it, placing *lapillus* (L.) in *Thais* along with many other species that had earlier been referred to *Purpura*. But Rehder (1962) provided a convincing photograph to show that the synonomy involves a variety of *lapillus* that is locally common in Europe but apparently absent from America. He concludes that the name *Nucella* Röding is, after all, valid. In which case *Nucella* takes priority over *Polytropa* Swainson and not only would the name be acceptable to define a sub-genus—as used by Dall (1909)—but also there would appear to be no *a priori* reason for ever placing it under *Thais*.

Advocates of *Nucella* thus simply refer to the species as *Nucella lapillus* (L.).

CONCLUSION

The specific epithet *lapillus*, meaning a pebble, used by Linnaeus (1758) is appropriate and takes precedence over all other names.

Buccinum Linnaeus (1758) and *Purpura* Bruguière (1789) have been re-defined and now exclude *Buccinum lapillus* L.

Nucella Röding (1798) is the next available name and takes precedence over *Polytropa* Swainson (1840).

Opinion is divided as to whether or not *Nucella* should be considered a sub-genus of *Thais* Röding. This will inevitable remain a matter of opinion but most recent British taxonomic lists have usually included the Common Dog-Whelk simply as *Nucella lapillus* (L.) and there seems to be no good reason to diverge from this opinion until more comparative studies have been made between *Nucella* and *Thais*.

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J. Conch. **27**: 376 (1972)

REVIEW

The Cowries of Seychelles. By David Slimming and Alan Jarrett, 32 pp., 15 plates, approximately 40p.

There is always a demand for a well-written introductory booklet, either for a certain taxon or a certain locality, and this demand is not necessarily a local one. In the present instance, the little book will be welcomed wherever shells are collected because, irrespective of its name derivation, the Seychelles have been a favourite collecting area for well over a century, and specimens from those islands must be very widely disseminated.

The book does indeed deserve a welcome, because it is designed to provide easy and accurate data on all the cowries known or recorded from the islands. The book starts with a map and a short introduction which includes a definition of the terms used, general features of the Cypraeidae and an appeal for conservation. Descriptions of the species follow; these are short but very lucid, and quite adequate for identification in all cases. They include size-range and habitat. The coloured illustrations are greatly superior to those usually offered in small books of the kind; background and lighting have been carefully chosen for a good three-dimensional effect, and the character of each shell has been most successfully brought out. All shells are portrayed natural size. The book has in fact, none of those snags which so often make themselves evident when one starts to use publications of the kind, and the work can be unreservedly recommended. Similar booklets on other families from the area may be hoped for.

T. E. Crowley

J. Conch. **27**: 377–386 (1972)

DORMANCY IN *LYMNAEA PEREGRA* (MÜLLER) DURING PERIODS OF DRYNESS

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(*Read before the Society*, 16 *October* 1971)

Introduction

Like other species of lymnaeid (Cawston, 1929; DeJesus & Mallari, 1937; Henderson, 1932; Mozley, 1928; Olsen, 1944; Patzer, 1927; Ross & McKay, 1929; Shadin, 1926), *Lymnaea peregra* (Müller) is able to survive for periods when its habitat dries up, and is included by Boycott (1936) in his list of British species which tolerate drying loci. Unlike the marsh-dwelling species which are primarily non-aquatic (Hunter, 1964), *L. peregra* is essentially aquatic in habit and when stranded out of water for long periods must enter a state of dormancy in order to survive.

Some of the factors concerned with the dormant state were studied in two natural populations of *L. peregra* occupying habitats which dry up temporarily. The site of field observations was Willow Lane ditch, Beverley, Yorkshire (Nat. Grid ref. 54/035385) and a pool in the corner of a field nearby. The stream is fed by drainage from neighbouring fields and a natural spring, the pool by drainage only. Both have bottoms of silt overlying clay, and both were without standing water for a period of three months. In the laboratory, an attempt was made to reproduce conditions similar to those which occur in the natural habitat. This was done by lowering the water level in large vessels containing the snails until they became stranded on the mud, which then dried. Observations were made on *L. peregra* under these simulated field conditions. Further observations and experiments were conducted on snails which had become dormant on glass slides in the laboratory.

The dormant state

In this study the term "dormancy" is adopted in preference to "aestivation" for although in some respects it resembles the condition defined by Wells (1944) as "aestivation", the period of inactivity does not seem to be directly dependant on seasonal factors. It occurred in the field only when the snails were exposed to prolonged periods of dryness, usually from mid-summer until late autumn; in the laboratory it would occur whenever the aquarium dried up. The dormant state in *L. peregra* was found to be readily recognised by the unusual posture adopted within the shell, which results in the side of the body, not the foot, being visible when the animal is viewed from beneath. This posture, illustrated in Fig.

1.a., instantly distinguishes dormant snails from those which are resting (Fig. 1.b.) and simply withdrawn.

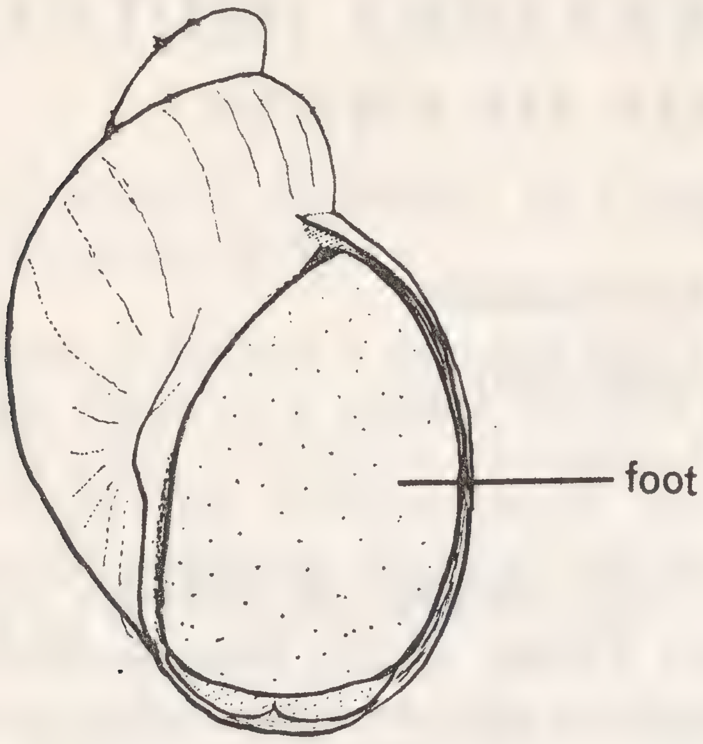

Fig. 1a. *L. peregra,* dormant condition.

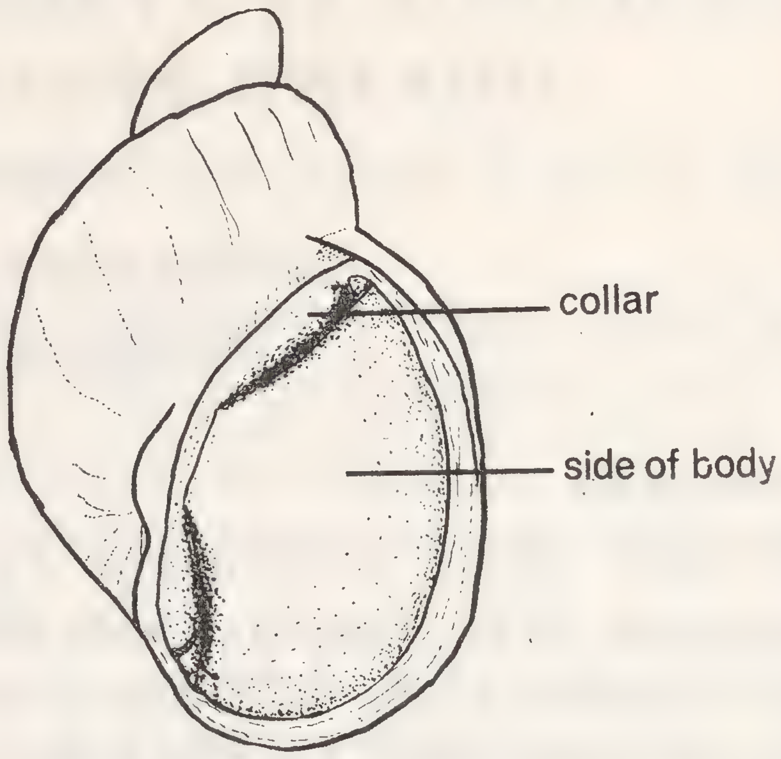

Fig. 1b. *L. peregra,* resting condtion.

Field observations

The sites were visited each day, from just before the water had evaporated until ten days after. On each occasion 20 snails, chosen at random from the pool and 10 from each of 5 selected sections of the stream, were examined for traces of dormancy. Mud samples from the same regions were collected in screw-top jars and later analysed for water content.

Initial observations showed that although most adult snails (shell height 11–12 mm.) were concentrated in the residual water, the young ones (shell height 2–6 mm.) crawled away from it and moved around on the wet mud. A small proportion of very small snails (under 2 mm.) had probably hatched directly onto the mud from eggs which had been stranded as the water receded, since some egg masses were found there also. When all the water had disappeared, most of the snails moved actively on the wet mud; this they continued to do for the next two days whilst the mud retained much of its moisture. As a result of their activities, the snails' shells received a coating of mud. By the third day the mud was becoming dry and cracks began to appear. Snails became increasingly difficult to find, since many of the smaller ones sought refuge in depressions and crevices. At this stage 40% of the adults examined were dead. None of the young snails had died however, and by the fourth day some were dormant. By the end of a week all the young examined were dormant and all the adults were dead. These changes are presented graphically in Fig. 2.

Snails did not appear to burrow below the surface of the mud to escape drying out, but to confirm this, quadrat frames (10 cm. × 10 cm.) were scattered at random over the surface of the mud 3 weeks and 3 months after the disappearance of the water. The soil beneath each quadrat was excavated to a depth of 10 cm. and the sample scrutinised at the site for distribution of snails. The results

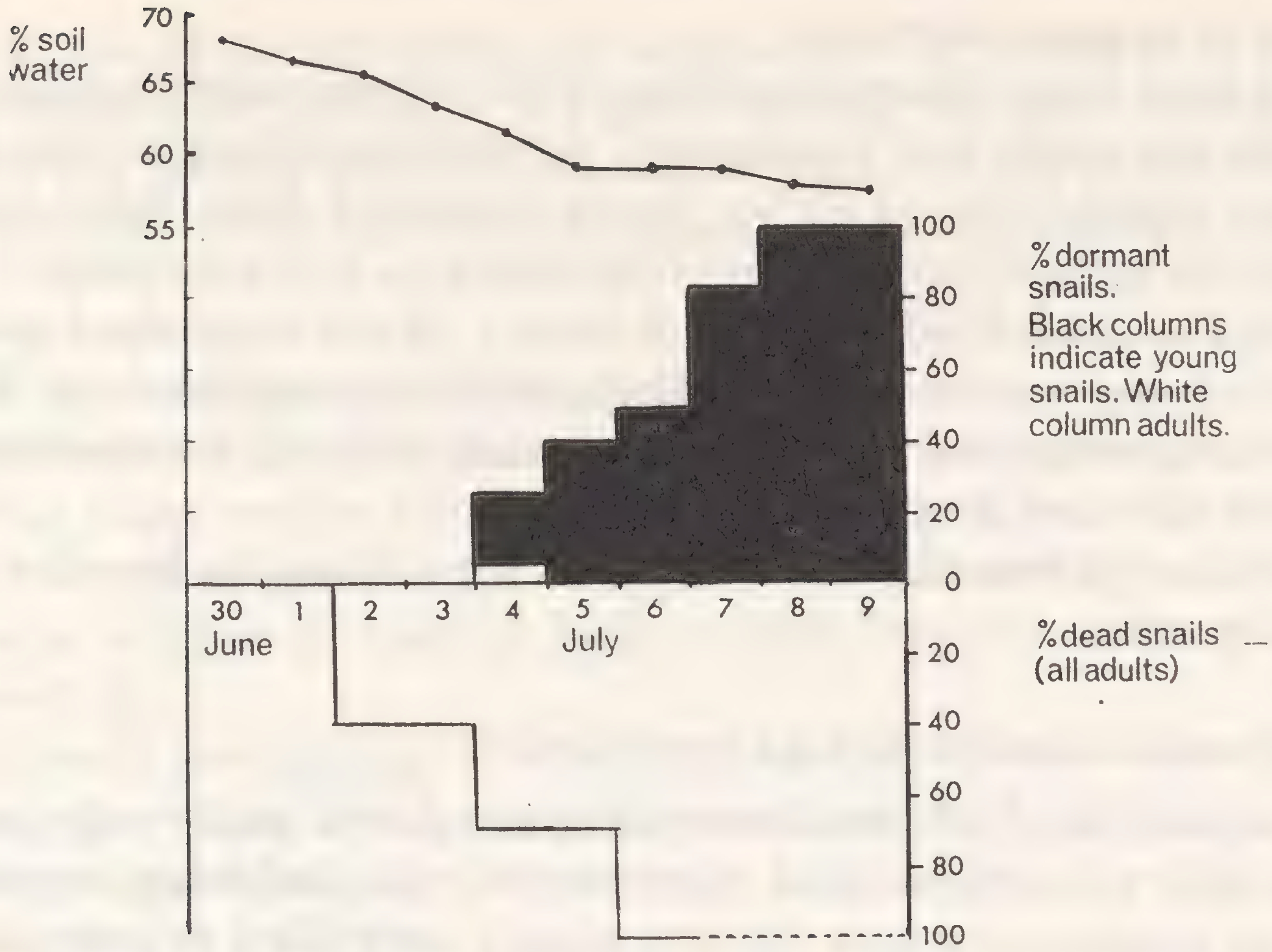

Fig. 2. Behaviour of *L. peregra* following the evaporation of standing water. (Field results.)

of the sampling were as follows. 307 snails from 14 quadrats were recovered from the dried mud, all of them from the surface. Most of them were not visible at first glance, partly because many had withdrawn into small depressions, pulling the edge of the shell into the mud, and partly because of the mud coating, which allowed them to blend with the surrounding soil.

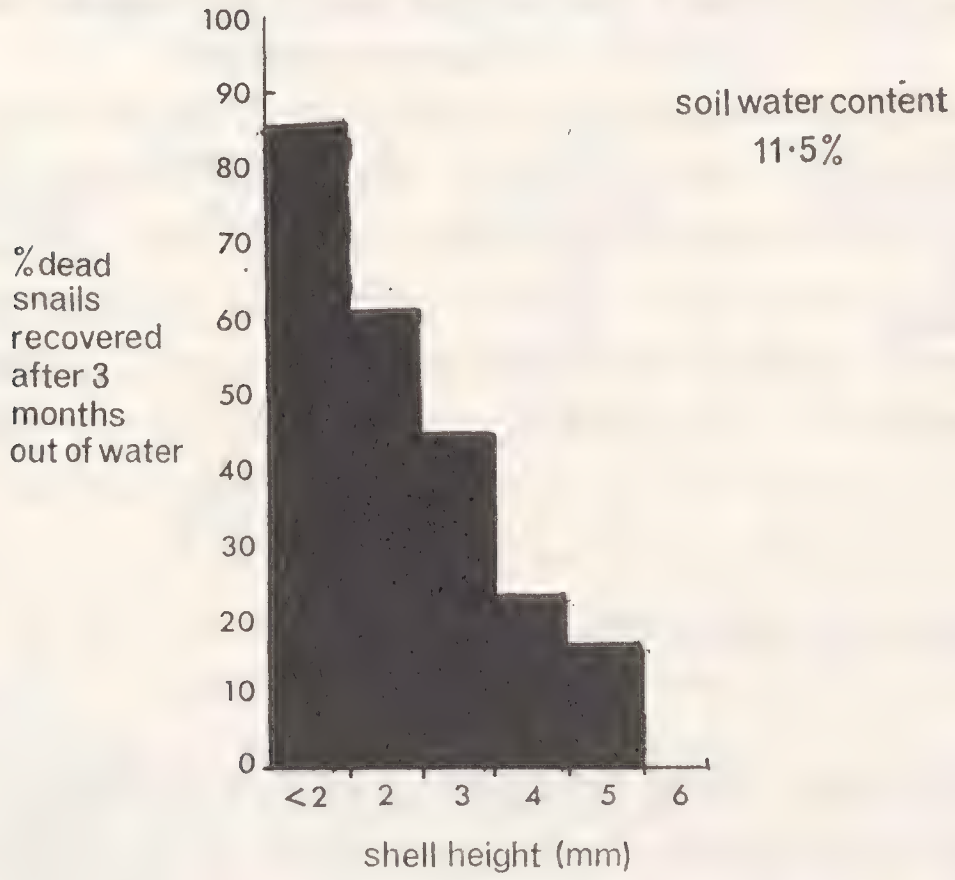

Fig. 3. Relationship between size and survival capacity in *L. peregra*. (Field results.)

Capacity for long-term survival

Samples of mud from different sections of the stream were examined for snails 3 months after the water had evaporated. At this time the mud was baked hard and the water content low (11·5%). Snails recovered from these samples were divisible into two groups, probably corresponding to two generations. Live snails were found in the small-sized group (1–6 mm.): all the large-sized group (11–20 mm.) were dead, and assumed to have died when the water dried up. The survival rate of the young snails was related to their size, (Fig. 3) the smallest being the first to feel the effect of long-term drying.

From a total of 278 snails examined, 116 were found to be alive and in the characteristic posture.

Experiments under simulated field conditions

To provide additional information relating the size of snails with their capacity for survival, and to confirm field observations, the following experiment was devised. Large earthenware pots (20 cm. diam.) were filled to a depth of 12 cm. with mud from the stream bottom. *L. peregra* of 4 size ranges were introduced and the containers flooded so that the snails were covered to a depth of 5 cm. The water levels were maintained by immersing the pots overnight in a large container filled with pond water. The pots were then removed from the vessel and allowed to dry out in a cool room in the laboratory. After 9 days the snails were examined for signs of dormancy, and placed in water to see if they were still alive. Their location in the soil was also noted.

The results (Table 1) again show for adults, increasing vulnerability with increasing size, augmenting field findings. Further evidence is the fact that the mean size of the surviving snails from these large and medium-sized groups was smaller than the mean of the groups as a whole, being 10·8 mm. and 7·7 mm. respectively. Long term survival capacity reflected field results.

TABLE 1

The relation between size of *L. peregra* and ability for long-term and short-term survival. (Laboratory results)

No. Snails Used	Size Category	Mean Size (mm.)	% Survival 9 Days	% Dormant	% Survival 2 months
50	Large	13·7	12	0	0
65	Medium	10·7	47	47	0
70	Small	3·8	100	100	72
50	V. small	<2·0	100	100	8
			% soil water 12·3		% soil water water 2·7

Relative humidity during experiment 65–80%.

None of the snails had burrowed into the mud, all being visible at the surface.

Also their behaviour during drying out appeared to be identical to that observed under field conditions, although the mud coating the shell was in most cases thinner. This last finding was attributed to the faster drying rate in the laboratory compared with the field, and the consequent shorter period of activity prior to dormancy.

Field and laboratory results indicate that:—

1. When stranded out of water, the snails move actively on the wet mud; in so doing many receive a coating of mud on their shells.
2. Snails do not respond to the disappearance of water by entering the mud, but seek shelter in existing hollows and become dormant as the mud becomes dry.
3. Adult snails (comprising 10% of the population) do not survive the initial drying up: young and juvenile stages are relatively immune.
4. Over prolonged periods of dryness, the survival rate of young and juvenile snails increases with size.
5. All surviving snails from the habitat are dormant and in a characteristic posture.

Laboratory experiments on water loss in L. peregra

In an attempt to relate field behaviour to the degree of water loss, weight losses from *L. peregra* of various sizes and in different phases of activity were measured and compared. Weight losses were determined gravimetrically using an analytical balance measuring to an accuracy of 0·1 mg., and the drying process was accelerated by keeping the snails in an atmosphere of constant saturation deficit, (35% relative humidity). The temperature, although not controlled, did not fluctuate by more than 0·5° C. during the experiments: mean temperature was 19° C.

It is well known that slugs and snails undergo periodic fluctuations in weight unconnected with feeding (Howes & Wells, 1934). Such cycles extend over a period of days however, and are therefore thought not to interfere significantly with short term experiments, normally lasting only minutes or hours. All weight losses were attributed to evaporative water loss during the experiment and no corrections were made for minor losses occurring for other reasons.

Weighings were conducted on individual snails during the various phases of their activities. Fig. 4 shows the results of such weighings on a snail of medium height (9 mm.) and is typical of 9 others of the same size. Because of the sensitivity of dormant snails to slight vibrations and even to changes in the atmosphere from room to room (Wells, 1944), weighings of snails in this condition was carried out on specimens which had become dormant on cover slips in the balance chamber itself, the pan and floor having been covered with plastic foam. Results show that the maximum water loss occurred during the initial period of being exposed to a drying atmosphere, when the snails were most active. As they became withdrawn, the water loss decreased, presumably since less of the moist

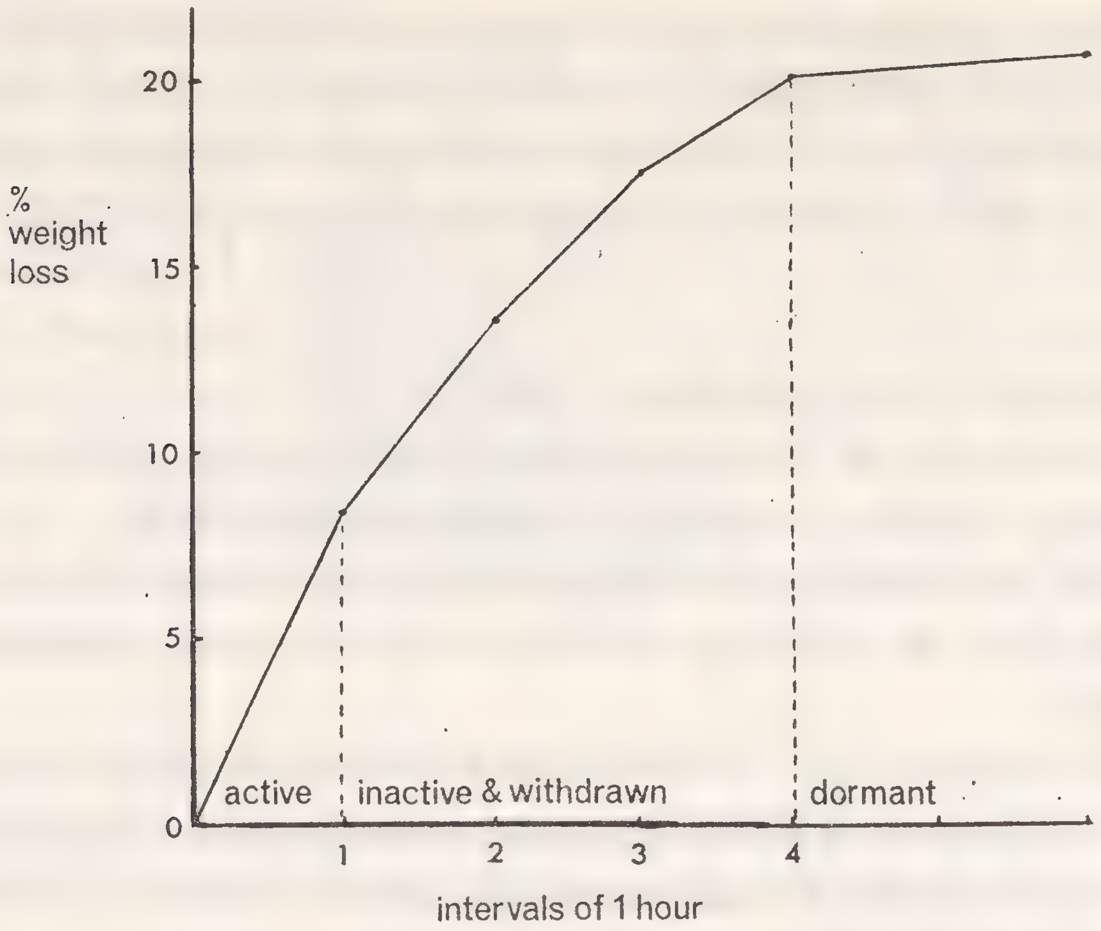

Fig. 4. Comparative rate of water loss in *L. peregra* during various phases of activity.

body surface was exposed to the drying atmosphere. The lowest rate of all was recorded when the foot slid sideways to expose the body wall in the typical dormant condition.

The comparative rates of water loss from *L. peregra* of different sizes are shown in Fig. 5, which represents group weighings of 124 specimens during a one hour

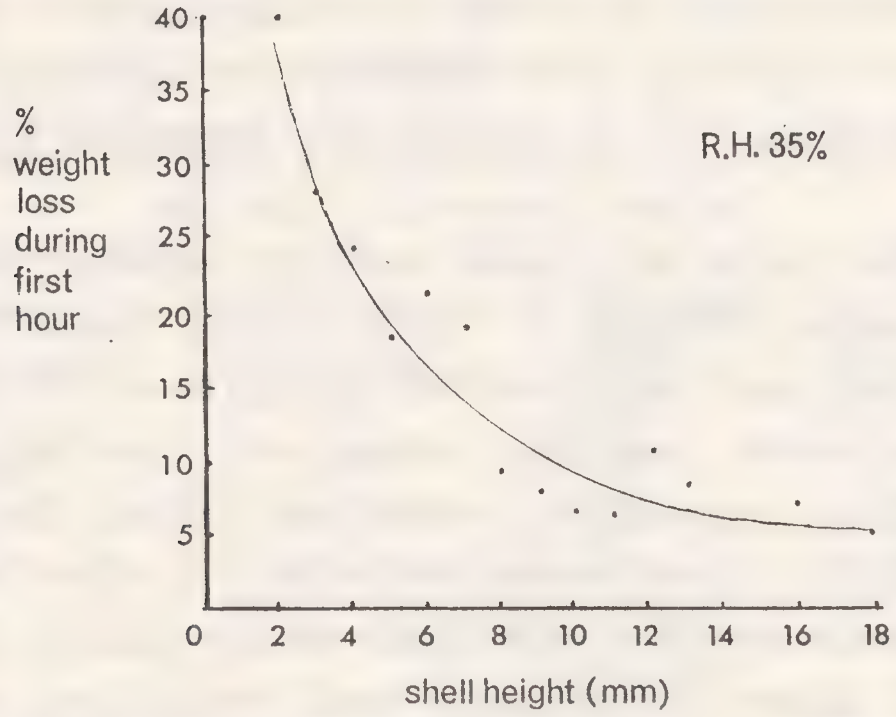

Fig. 5. Relationship between size and rate of water loss in *L. peregra*. (Laboratory results.)

period under similar conditions of temperature and relative humidity. During this period most snails were active and the results are therefore comparable. The results shown in Fig. 5 show that the rate of water loss is inversely proportional to the size of the snail. Over prolonged periods of exposure, even with reduced activity, the smallest snails would be at a disadvantage from the point of view of survival. These results are compatible with field and laboratory records of *L. peregra* stranded out of water for long periods, and indicate that a possible cause of death was desiccation.

Fifty specimens of *L. peregra* of various sizes were allowed to dry out in a desiccator and were found to range in their tolerance between 30% and 60% loss in body weight. Such levels of tolerance are not unusual for molluscs: slugs have been known to lose 50% (Dainton, 1954) and even 80% (Künkel, 1916) of their body weight and still recover.

Comparative water loss from foot and body wall

The lower rate of water loss of snails in the dormant posture compared with those simply at rest and inactive has already been shown (Fig. 4). In an additional series of experiments the rate of water loss from the foot was measured and compared with that from an equal area of the body wall. For these experiments the weights of large specimens of *L. peregra* were recorded at minute intervals whilst they were in the drying atmosphere of the balance chamber. The snails were secured so that the aperture faced upwards, and water loss via the shell was prevented by a coating of paraffin wax. Changes in weight were noted when snails were inactive, with only the moist foot exposed, and when they became active to expose both the foot and the body wall: the difference between these two rates was attributed to water loss from the body surface. Computed results showed that the rate of water loss per unit area from the body surface was always less than that of the foot. During one active period of one snail, the area of the body surface exposed was only slightly greater than that of the foot, and allowed a reasonably direct comparison to be made. The rate of water loss during this 24 minute period was calculated as 54·4 mg./hour from the foot compared with 17·3 mg./hour from an equal area of the body surface.

In the interests of water economy the benefit of replacing the foot surface, exposed during resting, by the lower evaporative surface of the body wall during dormancy, is now apparent.

Other observations

Like many terrestial pulmonates (Howes & Welles, 1934), *L. peregra* when dormant secrete a thin mucous veil, which may occlude the aperture completely or partially. In dormant snails removed from their habitat the veil was frequently complete, sometimes incorporating particles of soil or debris. Snails becoming dormant on glass slides in the laboratory were observed to produce copious quantities of mucus which was spread to the edge of the shell, acting as a cement at the shell-glass interface. Block (1971) quotes numerous workers who have found that thin epiphragms have little or no effect on water loss in dormant snails. The function of the mucus in *L. peregra* may well be in anchoring the snail to the substrate.

No measurements were made of the metabolic activity during the dormant period, but its rate was inferred from the following observations.

The alimentary canals of 25 snails were dissected and found to be devoid of food. The only material retained in the gut was a supply of mineral particles in the stomach region. It was not possible to tell whether the lack of food in the gut was due to their deliberately emptying it or simply due to food shortage prior to becoming dormant.

Once dormant snails were activated, breathing movements at once commenced. During a 12-hour period, whilst two snails were under continuous observation, no breathing movements were detected. It is possible that the pneumostome became active for periods after the observation period but this would have been a considerable reduction compared with resting snails in which the pneumostome was active between 1 and 18 exchanges per hour.

On certain snails from which the mud coating had previously been removed the beating of the heart could be observed through the semitransparent shell. The heart rate of 5 newly-activated snails (2·5–3·4 mm.) varied between 48 and 56 beats per minute. No heart beat was observable in the same snails prior to their re-activation and it seems likely that the activity of the heart in these dormant snails if not stopped completely, was considerably reduced either in amplitude or rate or both.

DISCUSSION

Studies conducted on two habitats which harbour *L. peregra* revealed some patterns of behaviour associated with the drying up of the water. During the period immediately following the disappearance of the water the snails move actively in the wet mud and in doing so receive a coating of mud on their shells. Behaviour of this type has been described for other pulmonates in drying habitats (Olivier & Barbosa, 1956), and results in their being difficult to see. This concealment could be of selective value, since once stranded on the mud, snails become more vulnerable to attack by predators.

Observations in the laboratory and in the field indicated that *L. peregra* do not burrow below the surface of the mud to avoid desiccation, a finding which contradicts an earlier observation by Cooke (1895), who recovered *L. peregra* from 3 inches below the surface of a dried-up pond at Cambridge. Burial may not favour the snails, however; Cawston (1929) found that *L. natalensis* (Krauss) quickly died when buried in garden soil at a depth of 2–12 inches, and other authors (Olivier & Barbosa, 1956); Perlowagora-Szumlewicz & Oliviera Dias, 1955) report the fatal effect of burial in other aquatic pulmonates.

Both in the natural habitat and in experiments under simulated field conditions the adult snails died shortly after the disappearance of the water. At this early stage, young snails, and those which, because of their small size were assumed to have recently hatched, survived. There can be little doubt that the adults which died, did so prematurely, and that their death was prompted by the drying up of the habitat, although whether the snails themselves died of dehydration or whether this simply accelerated the normal ageing process is problematical. Whatever the precise destructive agent, it operates on the adults, the young snails being unaffected. Whilst simulated field experiments suggest for adult snails a scale of vulnerability with increasing size, it is worth noting that the intermediate sized specimens used in this experiment were from a different habitat, and that different races of snail can vary in their resistance to desiccation (Olivier, 1956).

In the particular habitat investigated, the period of dryness was quite prolonged, in excess of 3 months, and although occasionally augmented by showers and dews, the amount of soil water was generally low. The smallest snails were the ones first to suffer the effects of prolonged exposure, the tolerance increasing with increasing size: this finding could be broadly correlated with their rate of drying out in the laboratory. Results are in agreement with studies on tropical pulmonates (W.H.O., 1957) which stress the importance of favourable ecological conditions for the survival of the young stages in view of their susceptibility to desiccation.

The ability of *L. peregra* to survive during periods of dryness was associated with their capacity to become dormant. The posture adopted by the snails during dormancy has not previously been described for this species, but appears to be important in water economy. Water which evaporates from snails is derived not from the body wall directly, but from a superficial layer of mucus (Machin, 1964). The change in partially-dehydrated mucus has been shown to reduce considerably the amount of water lost from the mantle collar of inactive terrestrial snails (Machin, 1966). Whether the reduction in evaporative water loss in *L. peregra* is due to similar changes in mucus composition is not revealed, but a reduction occurs, and corresponds to the removal from the aperture, of the foot, and its replacement by the side of the body.

Because of its fragility, the thin mucus sheet frequently produced by *L. peregra* prior to becoming dormant is not thought to be important in water economy. Fragments of the substrate occasionally become incorporated into this veil, an occurrence reported by Shadin (1926) from *L. palustris*. The adhesive properties of the dried mucus may assist in anchoring the snails to the substrate: dislodgement could result in the more vulnerable parts of the animals being exposed to wind and predators.

A reduction in the metabolic rate, inferred from observations on the heart and pneumostome, would be necessary for survival of the snails during long periods without food and water.

ACKNOWLEDGMENTS

I am obliged to the staff of the East Riding County Library for their help in tracing references, and to members of the Modern Languages staff of this school for translations of foreign texts. To Mr. D. Pallant, Mr. M. Heseltine and members of the sixth form of this school, I am grateful for encouragement and helpful criticism.

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VERTIGO LILLJEBORGI WESTERLUND IN NORTH WALES

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(*Read before the Society*, 16 *October* 1971)

INTRODUCTION

The distribution and ecology of the tiny land pulmonate *Vertigo lilljeborgi* Westerlund in Great Britain has been well documented by Kevan and Waterston (1933). Prior to this work the species was known only from scattered localities in western Ireland (Stelfox, 1929), and little ecological information was available. They showed that it occurred in many localities in Scotland and in a few in the Lake District of England; they also extended its known range in western Ireland. The species can now be included in the faunal list of Wales. Kevan and Waterston left little for others to glean and the additional information given here mostly refers to the appearance of the animal and its shell.

DESCRIPTION OF THE WELSH SITE

On 16 May, 1970 I collected nine specimens of what appeared to be *Vertigo antivertigo* (Draparnaud) in marshy ground by the bank of the Afon Glaslyn at Pont Croesor, near Prenteg, Caernarvonshire (Grid. Ref. 23/593415). Later it was realised that only five of the specimens were *V. antivertigo*, the other four being recognised as *V. lilljeborgi*. I re-visited the site, in the company of Dr. M. P. Kerney, in June 1970 (and, unaccompanied, on two other occasions subsequently).

At Pont Croesor, and for a few miles to the north and south, the Afon Glaslyn flows through a broad plain which is only a few feet above sea level and liable to frequent and extensive flooding. The vegetation, consisting principally of tall grasses and sedges, is luxuriant. Apparently it escapes close grazing by sheep and cattle because it is often inaccessible to them. All the living *V. lilljeborgi* were collected under the canopy provided by alder and willow bushes which line the Caernarvonshire side of the Afon Glaslyn at Pont Croesor.

On 24 June we searched intensively for about 45 minutes in an area of approximately 10 × 3 metres. Here the site was separated from the river by a low bank and was very wet underfoot. *Juncus* was abundant and the flora as a whole was apparently undisturbed by cattle or sheep. The molluscs found included 10 living *V. antivertigo* and two dead *V. lilljeborgi*. About 100 metres to the south-east, closer to the river and not separated from it by a bank, we investigated another small area. This was then under about 50 centimetres of water which was in direct communication with the river (earlier that day there had been a heavy and prolonged rainfall). Several living *V. lilljeborgi* and other molluscs were sieved from submerged vegetation. The next day the water had receded revealing a non-aquatic vegetation and a very waterlogged substrate. In about 20 minutes, working in poor light, we found 25 living *V. lilljeborgi* crawling on rotting vegetation. A plastic bag was filled with vegetation and sorted some days later; in this way a few more specimens were found.

The following molluscs were obtained from the site on 24 June: *Carychium minimum* Müller, *Lymnaea truncatula* (Müller), *Succinea pfeifferi* Rossmässler, *Cochlicopa lubrica* (Müller), *Vertigo antivertigo, V. lilljeborgi, Punctum pygmaeum* (Draparnaud), *Arion circumscriptus silvaticus* Lohmander, *A. subfuscus* (Draparnaud), *A. lusitanicus* Mabille, *Euconulus fulvus* (Müller), *Retinella radiatula* (Alder), *Zonitoides nitidus* (Müller), *Agriolimax laevis* (Müller).

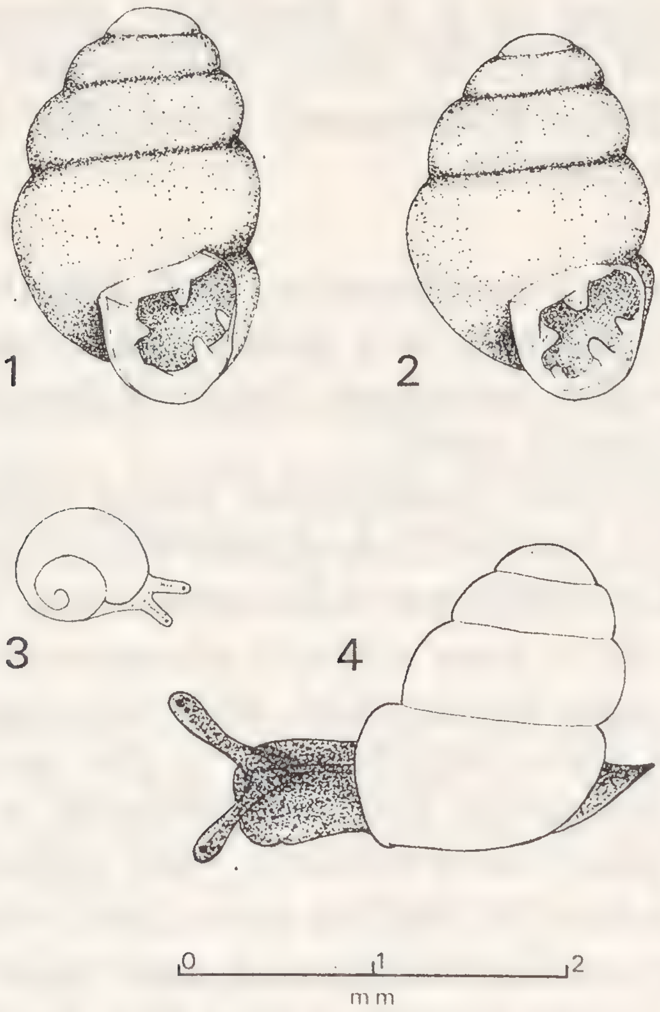
Essentially this list agrees closely with Kevan and Waterston's and indicates a marshy environment. The presence of *Arion lusitanicus* here is noteworthy (it was sieved from under the water) although I have found it in close proximity to stream water in one or two places in South Wales. *Living* specimens of *V. lilljeborgi* were not found associated with *living* specimens of *V. antivertigo* although populations of the two species were found only 100 metres apart. This confirms Kevan and Waterston's findings.

The following plants were collected for identification on 25 June and 14 August 1970, and 14 May 1971: *Equisetum arvense* L., *Caltha palustris* L., *Cardamine pratensis* L., *Filipendula ulmaria* (L.) Maxim., *Lythrum salicaria* L., *Oenanthe crocata* L., *Alnus glutinosa* (L.) Gaertn., *Selix* sp., *Lysimachia nemorum* L., *Veronica beccabunga* L., *Lycopus europaeus* L., *Galium palustre* L., *Aster novi-belgii* L., *Eupatorium cannabinum* L., *Juncus effusus* L., *J. inflexus* L. The following mosses were collected 25 June 1970: *Acrocladium cordifolium* (Hedw.) Rich. and Wall., *A. cuspidatum* (Hedw.) Lindb., *Climacium dendroides* (Hedw.) Web. and Mohr., *Eurhynchium praelongum* (Hedw.) Hobk., *Mnium affine* Bland, *M. cinclidioides* Huben. The following liverworts were also collected 25 June 1970: *Chiloscyphus pallescens* (Ehrh.) Dum., *Marchantia polymorpha* L., *Radula complanata* (L.) Dum.

This list is similar to that given by Kevan and Waterston (although they did not list the mosses and liverworts by species). Again it confirms their conclusion that the places frequented by *V. lilljeborgi* are marshy and often flooded.

THE SHELL AND ANIMAL

Kevan and Waterston discuss the variation in shape and dentition of the shell. They conclude that the "normal form" of the species has four denticles but that a form with five denticles is fairly common; examination of abundant materials from 32 widely-scattered localities showed that 4-denticled specimens were much more numerous, occurring in the ratio of 17 : 3. A total of 63 specimens collected at Pont Croesor on four occasions in 1970 included 42 of the 4-denticled form (Fig. 1) and 21 of the 5-denticled form (Fig. 2), this represents a ratio of 2:1 in favour of the 4-denticled form. Kevan and Waterston summarise the chief differences between the shell characters of *V. lilljborgi* and the other species of *Vertigo* with which it may be confused.



Figs. 1–4. *Vertigo lilljeborgi* Westerlund, from Pont Croesor, near Prenteg, Caernarvonshire. S. P. Dance leg. 1970. Fig. 1. An example of the 4-denticled form. Fig. 2. An example of the 5-denticled form. Fig. 3. Immature example, about two days old. Fig. 4. Mature example, drawn to illustrate the shape and orientation of the tentacles.

No descriptions or illustrations of the animal of *V. lilljeborgi* are readily available at present. The Pont Croesor material shows that newly hatched examples are translucent pale grey (Fig. 3). Mature ones are almost black, the tentacles being short, thick and club-shaped and widely divergent (Fig. 4). They can be fairly easily distinguished from *V. antivertigo* in which the tentacles are subcylindric, obtusely pointed and less divergent.

ACKNOWLEDGMENTS

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J. CONCH. **27**: 390 (1972)

REVIEW

New Zealand Seashells in Colour by J. R. Penniket; photographs by G. J. H. Moon. Published July 1971 by A. H. & A. W. Reed, Wellington, New Zealand. U.K. agents Bailey Bros. & Swinfew Ltd., Folkestone, Kent. Pp. 112 with 51 colour plates $6\frac{7}{8}$ ins. × $7\frac{1}{4}$ ins. U.K. price £2.25.

For the tyro shell-collector an inexpensive, well illustrated *book* of the shells of the country in which he is collecting is a great asset. For the experienced collector in New Zealand Powell's book is excellent, but it is too advanced for the beginner. This book should therefore meet a need.

The photographs are good, the illustrations being large, and in nearly all cases the shells are against a background which shows them up well; Plate 23 "Trophon Shells" is an exception. A size indicator, such as a coin, included with each photograph would have helped to show sizes without reference to the text.

Although the beginniner may be satisfied with the local or common name of a shell, he will very soon find the scientific one is the name he must use. Not only is the latter used by serious collectors and conchologists who may perhaps know the common name of shells of their own country, but collectors in other parts of the world are most unlikely to know it. And it is unlikely that he will collect for long without exchanging at least correspondence if not shells with fellow collectors in many other countries. It is a pity therefore that this book has given priority to the common New Zealand names where they exist. It would have been tidier and preferable to have given the scientific name first and the common name, where there is one, in parenthesis. It is a pity too that the author's name is not given with each shell.

An error such as that "Molluscs are divided into five classes" is also regrettable.

It is very helpful, especially for the beginner, to be able to carry a reference book in one's pocket when on shelling expeditions. Had this book been produced so that it would fit into the normal pocket it might have lost something aesthetically but would have been far handier for the collector.

How many, many books on innumerable subjects would have been improved by the inclusion of a map! This is no exception. A map of New Zealand giving the place names mentioned in the text would have been most helpful, especially to the non-New Zealander who is interested in the country's shells but has not had the opportunity of going there.

Despite these criticisms this book is likely to be appreciated by many visitors to New Zealand beaches, and the author and photographer should be congratulated on their efforts to meet what must have been a growing need in today's world of fast growing numbers of enthusiastic shell collectors and embryo conchologists.

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J. Conch. 27: 391–396 (1972)

THEBA PISANA IN GUERNSEY, 1971

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(*Read before the Society*, 16 *October* 1971)

Introduction

During a study tour of the Bailiwick of Guernsey in the summer of 1971, some shells of *Theba pisana* (Müller) were found on the Hommet headland at the north end of Vazon bay. Since I was at that time making a study of the distribution of the land snails of the Bailiwick, I returned to make a more detailed investigation of this locality and to record the extent of *T. pisana* on the west coast of Guernsey.

Dr. F. C. Lukis introduced *T. pisana* to Guernsey in 1860 when he placed small colonies at Vazon Bay, on the slopes of Vale castle and just north of Bordeaux village. He also sent some to his sister, Mrs. Collings, in Sark, but these did not establish (Tomlin 1925). The occurrence of *T. pisana* in Guernsey has been reported subsequently by Rimmer in 1873, Tye in 1877, Cooke and Gwatkin in 1877, Marquand in 1894 (all in Crowley, 1961), Tomlin (1925) and more recently by Crowley (1961). All of these showed that *T. pisana* still persisted in Guernsey. The following account describes its present distribution and adds to that of Crowley (1961).

Present Distribution

In early August 1971 a second visit was made to the Hommet headland (Fig. 1). The snails were found by the hundred, both young and adult, in a ditch on the north eastern side of the road leading onto the headland and just a few yards short of the shore of Albecq Bay (U.T.M. grid 286804). They were found on the floor of the ditch and aestivating (at heights of up to 40 cms.) on any vegetation that was strong enough to support them. Besides *T. pisana, Cochlicella acuta* (Müller) and *Helicella caperata* (Montagu) were very abundant. There were many dead shells of *Theba pisana* on the surface.

In this area the headland is low-lying (below 8 metres) and is covered by a deposit of shell sand. A little to the south there is a marshy area. The ditch has been dug into the shell sand and, although it did not contain water at this time, it was clearly damper than its surroundings. Whilst the sandy areas around were largely covered in grass, the ditch also contained sorrel (*Rumex*), broomrape (*Orobanche*), hawkweed (*Hieracium*), and some small Umbelliferae with very fine, lace-like, flower heads. It was on these plants that many of the snails were found.

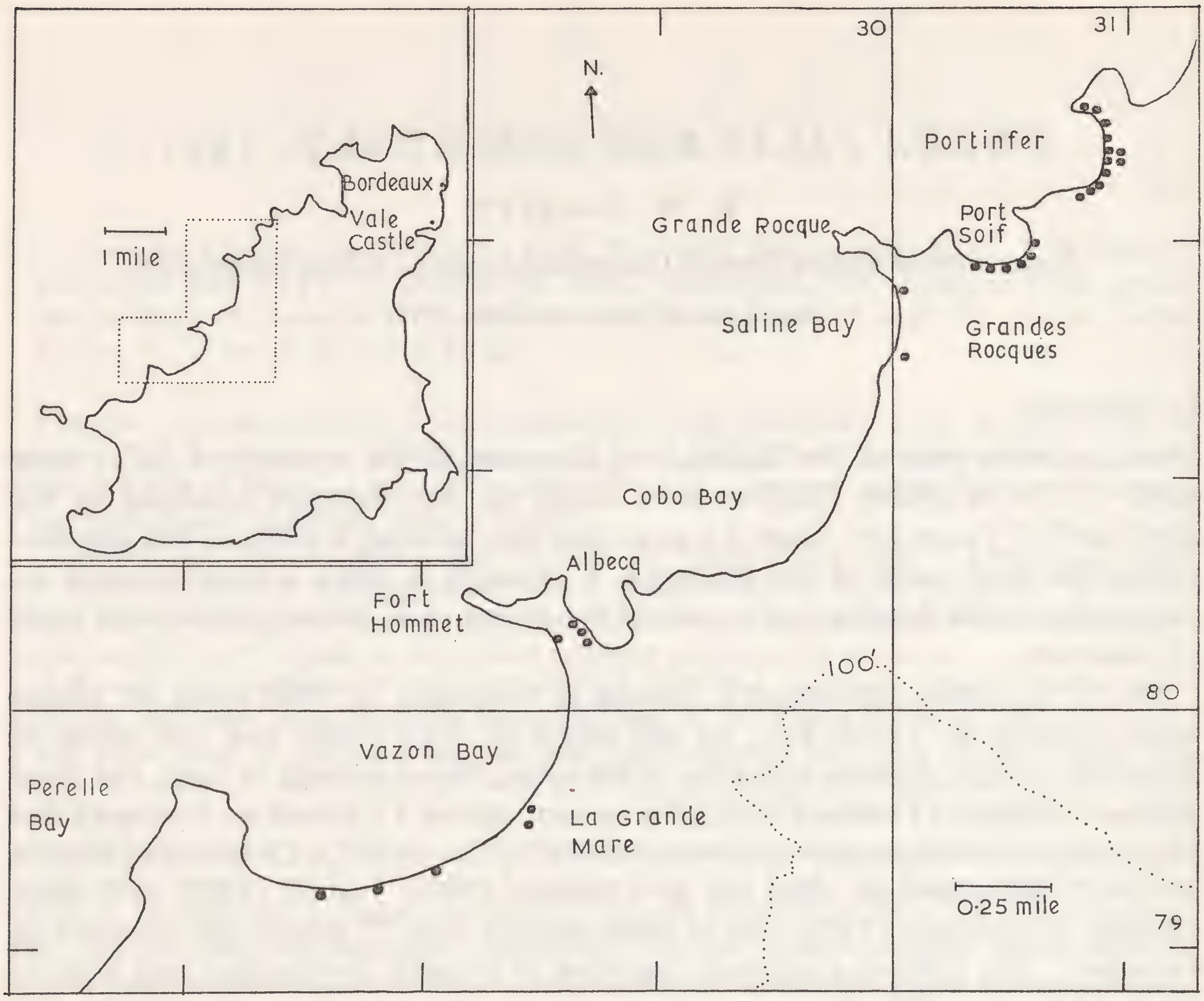

Fig. 1. The distribution of *Theba pisana* (colonies marked: ●) along the west coast of Guernsey. (Map based upon the Ordnance Survey map with the sanction of the Controller of H.M. Stationery Office, Crown Copyright reserved).

Tracing the ditch landward, *T. pisana* continued to be quite common, but none was found on the turf bordering Albecq Bay or in the ditch on the other (S.W.) side of the road. However, *Helicella caperata* and *Cochlicella acuta* were abundant in these places. On the southern side of the headland, near the end of the Vazon sea wall (285804), *Theba pisana* were again found in abundance. They occurred in the turf on the slopes of some German defences and especially around and on the north-east wall of a wooden tea hut. A careful search of the higher, rocky and granitic part of the headland (i.e. the seaward end) revealed only a few *Helicella caperata* and *Helix aspersa* Müller.

Continuing north-eastwards along the coast, the next locality in which *Theba pisana* was found was near the southern end of Saline Bay at 301815. In this area the coast road follows a ridge of sand around the head of the bay, and at the reference given the snail occurred on the inland slope of this ridge. Once again the habitat was one of shell sand and the snail was found where the vegetation was rarely cut by man. It was most abundant on clumps of sea radish

(*Raphanus maritimus*) and ragwort (*Senecio*) within the turf. *Cochlicella acuta* and *Helicella caperata* were numerous and a few *Hygromia hispida* (L.) and *Oxychilus draparnaldi* (Beck) were also found. The same type of habitat persisted along the top of the coastal ridge northwards, excepting that the plants were sometimes trimmed, and although *Cochlicella acuta* and *Helicella caperata* continued to be abundant, *Theba pisana* was not found.

At the northern end of Saline Bay, at the inland end of the Grande Rocque headland (301818), a colony of *Theba pisana* was found on either side of a path leading onto the beach. The snails were aestivating on marram grass (*Ammophilia arenaria*) and ragwort which was growing in a very exposed position on shell sand just above the beach. As at Hommet, they did not occur on the rocky part of the headland.

Further to the north *T. pisana* again occurred in sandy areas beside the coast at Port Soif and Portinfer. At the latter the snail was so abundant that many were crushed at each step. They carpeted the ridge at the head of the bay, its inland slope, a low-lying field beyond and a sandy lane leading to the coast, especially in the locality of 309824. *T. pisana* was especially abundant on ragwort, sea radish and marram, but every plant with broad leaves was well covered. In association was the by now familiar assemblage of *Cochlicella acuta* and *Helicella caperata.*

Traced north-eastwards the *Theba pisana* died out at the next headland (308826) where the sand gave way to rocks and a rocky rubbish tip. The only exception was along a narrow band of sand that persisted a little along the southern and western coasts of the headland. No further snails of this species were found on the coasts to the north east, even in areas with shell sand or with suitable vegetation.

Returning to Vazon Bay, *T. pisana* was found at a number of localities south of the Hommet headland. The first was at La Grande Mare (285796) where there was a thriving colony on the sandy slopes beside a German bunker. As before, most snails were aestivating on the stems of plants, in this case various grasses and sea radish. Some albino varieties were found here. A few *T. pisana* were also found on the inland side of the wall beside the coast road just to the north-east, as reported by Crowley (1961), while further to the north-east, in spite of the presence of a fairly neglected area of grass and sea radish inland of the coast road, there were no further speciments of this snail. In all these areas, *Cochlicella acuta* and *Helicella caperata* were abundant. There were no snails of these kinds on the seaward side of the road, which is the paved area described by Crowley.

Continuing south-westwards around the coast of Vazon Bay *Theba pisana* was found on the seaward side of the road at specific localities behind the sea wall. As at Saline Bay, the coast road at Vazon follows a bay head ridge and on the inland side of the road there is a grassy area in those places where the ridge is wider than the road. This grass showed evidence of regular cutting and no *T. pisana* were found here. On the seaward side of the road, colonies of the snail were found beside the public conveniences at 282794, by a bunker and tea hut at 278793 and by another bunker at 276792. In each case they occurred in sandy areas where grass, sea radish, hawkweed and ragwort were growing. Although these conditions continued further around the bay, including bunkers at 273794 and 273795, no further *T. pisana* were found. Nevertheless *Helicella caperata* and *Cochlicella acuta* were abundant at each of these localities.

Searches at Perelle Bay, particularly in suitable habitats, revealed no further *T. pisana*. Thus the south-westernmost occurrence was at 276792.

Having investigated the distribution of *T. pisana* along the west coast of Guernsey, an attempt was made to find it at Vale castle (357817) near the east coast. A habitat similar to those where the snail was found in the west was found on the south-east side of the castle between the coastal car park and the sea. The soil was sandy and there was relatively uncontrolled growth of grasses, sea radish and umbelliferae. *Helicella caperata* and *Cochlicella acuta* were abundant, but there were no *Theba pisana*. A search was also made of the castle area and of the rocky slopes leading down to the sea, but without success.

DISCUSSION

From the foregoing description it is clear that *T. pisana* is abundant at specific localities on the west coast of Guernsey between northern Portinfer and south-central Vazon. This distribution is similar to that recorded by Tomlin in 1925 although he did not report it north of Grandes Rocques. Since it was introduced at Vazon in 1860, and had spread to Grandes Rocques by 1925, it would be reasonable—subject to the availability of suitable habitats—to expect it to be more widespread in 1971. The present investigation showed this to be so. The rather limited distribution in Vazon Bay recorded by Crowley (1961) probably reflected the influence of the periods of construction in this area both during and after World War II. It is interesting to note, however, that the German bunkers now appear to have a considerable positive influence on the distribution of *T. pisana* as will be outlined below.

The distribution of *T. pisana* between Vazon and Portinfer Bays is variable in its pattern. At Portinfer and Port Soif Bays there is a continuous and very dense population, while at Saline Bay, Grande Rocque and most of the Vazon localities the distribution of these snails is much more localised and usually of a high population density. A common feature of each locality where *T. pisana* occurs is the presence of a sand rich in shell material, and at Albecq this sand was found to be above pH 8.

The west coast of Guernsey comprises a series of rocky headlands between which are sandy bays. On the inland margin of each bay described in this paper there is a ridge of blown sand and beyond there is usually a swampy area. It was on these ridges of shelly sand that *T. pisana* occurred. But whilst every *T. pisana* colony was found on shelly sand, not all areas of shelly sand between Vazon and Portinfer were colonised by these snails. Thus in Cobo and parts of Saline and

Vazon these snails were often absent, but normally only where the ridge had been built upon or where the grass was regularly cut.

The sporadic distribution of *T. pisana* in Vazon would seem to give added support to the correlation between this snail and shell sand, for the snail occurred in dense colonies where sand had fairly recently accumulated around obstructions. Thus the colonies were found beside the German bunkers and beside a cess pool cover by the public conveniences. It was also noticeable that the vegetation by these features was largely undisturbed by man.

Along the entire coast between Vazon and Portinfer it was also clear that wherever the sandy areas gave way to stony or rocky ones, *T. pisana* no longer occurred. Such areas appeared to be more acid than the sandy ones and very few snails were found there.

The spatial relationship between *T. pisana* and shelly sand was matched by a similar relationship with certain types of plants. These were sea radish, sorrel, hawkweed, ragwort and umbelliferae. Not all these were present in every colony, but there was always one or more as well as the various grasses. In many cases the snails were to be found most abundantly actually on these plants and it would seem that they provided the snails with the means of climbing above the hot ground surface (Boycott 1934). They may also supply the snails with food for several of these types of plants were seen to have leaves with many holes and a few scraps collected with the snails were also eaten. However, although the snails favoured habitats with these plants, they did not occur in every place that these plants grew, not even where the soil was sandy.

As has been indicated, it would seem that human interference has limited the snail's occurrence. Another clear example of the influence of man was seen at Grande Rocque. Here *T. pisana* was abundant on marram grass on either side of a track leading to the beach, and it was apparent that this track funnelled the tourists' routes to the beach. But further along the shore, where there was no definite track, the marram was more trampled by tourists and *T. pisana* was not found.

Another feature of the distribution of this snail was the association in every case of equally dense or more dense populations of *Cochlicella acuta* and *Helicella caperata*. Indeed, wherever these snails occurred with sand and sea radish, one expected to find *T. pisana*. In many cases this was so, but where the sward was cut in Vazon and Saline, *T. pisana* was absent from this species assemblage. Beyond the areas where *T. pisana* occurred, this association of snails and habitat continued, and this suggests that *T. pisana* could one day be more widespread in Guernsey.

Thus far the ecological factors influencing *T. pisana* in Guernsey are substantially the same as those given by Turk (1966). Guernsey, in common with the other British localities for *T. pisana*, has mild winters and comparatively frost-free conditions, and it could certainly be claimed that much of the island has a sunny aspect and a genial climate. Also the snail is found exclusively in areas with a highly calcareous soil.

In respect of shelter, however, agreement is less complete. The west coast of Guernsey is very exposed, especially to the prevailing wind, and although some colonies were found in sheltered localities (i.e. in a ditch, in the lee of a sea wall), others were not. The Grande Rocque colony was on a very exposed dune with marram grass, and when observed the grass was waving violently in a strong cool wind. Similarly there was no shelter for the very abundant spread of snails on the beach ridge at Portinfer and Port Soif. These latter observations would seem to lend agreement with Mr. L. W. Stratton's comments in Turk 1966. In general the Guernsey evidence would suggest that the presence of suitable plants and soil is more relevant than shelter.

Summary

Theba pisana was introduced into Guernsey from Jersey in 1860. An investigation of its distribution in August 1971 confirms the findings of Tomlin (1925), extends the range north-east of Grandes Rocques and locates the colonies using six-figure map references. At particular localities the snail was very abundant and its distribution can be closely correlated with blown calcareous sand and certain types of plants. Since similar conditions are found elsewhere along the west coast, there would seem to be scope for future colonisation. Evidence suggests that only limited human interference can be tolerated. At the northern end of its range, climatic factors—especially mild winters—are important, but the significance of shelter, at least in summer, is less clear.

ACKNOWLEDGMENT

I am very grateful to Dr. June Chatfield for reading and commenting on the manuscript and for her help with the various identifications.

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J. Conch. **27**: 397–400 (1972)

A PROPOSED TERMINATION TO THE WIDELY ACCEPTED JUNIOR SYNONYMY OF *CARDIUM PARVUM* TO *C. EXIGUUM*

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INTRODUCTION

Cardium parvum Philippi (1844) was recognised as a valid species for more than half a century (Bellini, 1902). It was first synonymised to *C. exiguum* Gmelin (1791) by Bucquoy, Dautzenberg and Dollfus (1898) and this was confirmed by recent authors such as Keen (1937), Bowden and Heppell (1968) and Nordsieck (1969). This has led to the rejection of the specific status of *C. parvum*, which was selected by Crosse (1885) as the type species of the genus *Parvicardium* Monterosato (1884), and the consequent recognition of *C. exiguum* var *commutata* B.D.D. as the type species for this genus name.

THE NOMENCLATURE OF THE SPECIES

It should be noted that we accept the designation of *Cardium aculeatum* L. by Lamarck (1799) as the type species for the genus *Cardium* (Høpner Petersen and Russell, 197lb).

The name *parvum* was used first by Da Costa (1778), apparently for very young specimens of *C. aculeatum* or *C. echinatum* (Bucquoy, Dautzenberg and Dollfus, 1898), then by Mawe (1823, probably for young *C. glaucum*, and later by Sowerby (1840) for a small cockle of unknown origin in the Cuming collection. Later still, apparently unaware of its prior usage, Philippi (1844) used the name for a small cockle taken from Lake Fusaro, near Naples (Italy). This confusion could well provide a basis for an application to the International Commission for Zoological Nomenclature for the abandonment of *parvum* as a *nomen dubium*.

The next available name would appear to be *commutatum* B.D.D. (1898). Despite the fact that the authorities did not recognise the specific status of *C. parvum*, *C. commutatum* heads their list of species given under their subgenus

Parvicardium; indeed, the authorities recognised the priority of Da Costa to the name *parvum* stating, ". . . . nous nous voyons forces de donner à cette forme (the variety of *C. exiguum* which they considered equivalent to '*C. parvum* Philippi *ex parte*') un nom nouveau . . . .". Bucquoy, Dautzenberg and Dollfus (1898) also equated their variety *scripta* of *C. exiguum* to *C. parvum* Philippi (non Da Costa) *ex parte*; we doubt the affinity of those shells figured by the authorities under the name var. *scripta* B.D.D. to *C. exiguum* (see later). A suitable alternative might be *parvulinium* Locard and Caziot (1900). This name was proposed as a direct synonym to *parvum* Philippi, possibly for the reason of Da Costa's priority to *parvum* but more likely to give that name a better latin form. Until this problem has been resolved we shall use the name *parvum* Philippi in accordance with the majority of authors.

EVIDENCE FOR THE ACCEPTANCE OF THE SPECIFIC STATUS OF *C. parvum*

Historical

Our acceptance of *C. parvum* as a valid species is based on a thorough examination of the relevant literature in the light of our recent work on other shallow water *Cardium* species (Høpner Petersen, 1958; Russell, 1969 and 1971b; and Høpner Petersen and Russell, 1971a & b) bearing in mind the modern concepts of a species. We suggest that the following facts should be considered:

1. Philippi (1844) was well acquainted with all the small European *Cardium* species recognised today (i.e. *papillosum, exiguum, fasciatum* (= *ovale*), *minimum* and *scabrum*) and himself erected the latter two together with *C. parvum*. Philippi described *C. exiguum* with great accuracy, mentioning its capability of producing byssal threads and climbing in vegetation (c.f. Høpner Petersen and Russell, 1791b), of which he made no mention in his description of *C. parvum*.

2. *C. parvum* was recognised, in conjunction with *C. exiguum* and often with all the other aforementioned small *Cardium* species, by many well known conchologists working in the Mediterranean area, for example Requien (1848), Weinkauff (1862), Brusina (1866), Monterosato (1878 and 1884), Dautzenberg (1883 and 1886), Locard (1892) and Locard and Caziot (1900).

3. Bucquoy, Dautzenberg and Dollfus (1898) did not recognise other Cardium species which had been adequately described and figured by earlier authors, for example *C. glaucum* Bruguière, which is now widely accepted as a valid species (Bowden and Heppell, 1968; Nordsieck, 1969, etc.).

4. Those authors who accepted the junior synonymy of *C. parvum* to *C. exiguum*, for example Keen (1937), Bowden and Heppell (1968) and Nordsieck (1969), are taxonomists from America and northern Europe and therefore have had no reason to acquire a specialised knowledge of Mediterranean material. It should be noted that *C. parvum* has not been reported from outside the Mediterranean. Further, Nordsieck (1969) equated *C. parvum* and *C. commutatum* B.D.D. to his subspecies *Parvicardium exiguum parvum*, of which his description,

with reference to costal sculpture, appears to bear little relationship to Philippi's figure and description of *C. parvum*.

5. Prior to the work of Bucquoy, Dautzenberg and Dollfus (1898), *C. parvum* was related not to *C. exiguum* but to *C. fasciatum* (= *ovale*); for example, Forbes and Hanley (1853) and Locard (1886) listed *C. parvum* as a junior synonym of *C. fasciatum*. Philippi (1844) finished his observations on *C. parvum* as follows: "... Nonne *C. fasciatum* Mont. Sup. p. 30. t.XXVII. f. 6.? ..." (Possibly *C. fasciatum* Montague ... etc.); indeed, the figure of *C. parvum* given by Philippi (1844, plate XIV, fig. 17) shows costal sculpture on both the anterior and posterior ribs but not on the more central ones, a feature in common with *C. ovale* (Tebble, 1966 and personal observations) but not with *C. exiguum* (Høpner Petersen and Russell, 1971b).

Museum material

From a close examination of the material housed in the Copenhagen Zoological Museum and classified as either *Cardium exiguum* or *C. glaucum* we consider the following observations are significant:

1. Some shells from the Mediterranean coast of Israel were clearly identifiable as *C. parvum*.

2. The frequent misidentification of small specimens of *C. glaucum* as *C. exiguum* has been reported previously (Høpner Petersen and Russell, 1971b) and we suggested that many small specimens of *C. glaucum* resembled very closely the *C. exiguum* var *scripta* figured by Bucquoy, Dautzenberg and Dollfus (1898, Plate 45, figs. 13–18 inc.) and to which they equated *C. parvum ex parte*, commenting as follows: "... C'est elle (the var *scripta*) que la plupart des conchyliologues modernes ont designée sous le nom de *Cardium parvum* Philippi. ...".

CONCLUSION AND DISCUSSION

We consider that, based on the evidence outlined above, *C. parvum* Philippi (non Da Costa) should be recognised as a valid species distinct from both *C. exiguum* and *C. glaucum*. The genus name *Parvicardium* must be based on *C. parvum*, following the designation by Crosse (1885); thus *C. exiguum* var *commutata* should no longer be regarded as the type species of *Parvicardium* Monterosato (1884). We suggest that the varieties *scripta* and *commutata* (B.D.D., 1898) of *C. exiguum* need further elucidation, preferably from an examination of their original material. Also, more material needs to be examined in order to elucidate the relationship between *C. parvum* and *C. fasciatum*; we accept the possibility that these names may be synonymous. We are considering the nomenclatural validity of the name *parvum* and certain suggestions will be presented to the I.C.Z.N. in due course.

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A SIGNIFICANCE IN THE NUMBER OF RIBS ON THE SHELLS OF TWO CLOSELY RELATED *CARDIUM* SPECIES

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INTRODUCTION

Raised ridges radiating from the umbo represent the principal shell sculpture in cockles (Cardiacea). The number and form of these ribs and the processes which they may bear are important features in the diagnosis of *Cardium* species (Høpner Petersen, 1958, Turk, 1964 and Tebble, 1966). Of the many *Cardium* species it would appear that *C. edule* Linnaeus has been studied the most extensively with respect to the variation in the average number of ribs in different populations. However, the majority of workers including Loppens (1923) and Eisma (1965), both of whom made extensive studies in this field, did not recognise the specific status of *C. glaucum* Bruguière (c.f. Bowden and Heppell, 1968 and Russell, 1969). As a result *C. edule* has been considered to exhibit an extreme morphological variability (Bucquoy, Dautzenberg and Dollfus, 1898), to occupy a wide range of habitats (Loppens, 1923) and to have an extensive geographical distribution throughout Europe (Tebble, 1966), all of which have been refuted by recent work in the light of the recognition of *C. glaucum* (Russell, 1969 and 1971). Thus it became necessary to re-examine both the intra-specific and inter-specific variation in the number of ribs on the shells of these two species.

MATERIALS AND METHODS

The samples of *Cardium edule* and *C. glaucum*, which were separated using those characteristics of taxonomic importance (Russell, 1969) were collected alive from 32 widely distributed localities in Europe, from which environmental data have also been recorded (Russell, 1969).

The ribs, which were defined as being raised calcareous ridges radiating from the umbo and bearing scales, were counted whilst the shells were wet, since the priostracum became taut on drying, often bridging the gaps between small ribs and flattening the triangular scales in *C. glaucum*, on which the posterior ribs are often poorly developed (Høpner Petersen, 1958). The uncertainty of whether certain raised ridges on the posterior ends of some valves were genuine ribs (Walton, 1919) was encountered but overcome both by using the criteria applied by Eisma (1965) and counting all the ribs personally, any error thus being minimal and constant. Double ribs (Eisma, 1965) and multiple ribs (Girscher, 1940) were encountered on a few shells; the former was counted as two ribs and the latter accounted for the rejection of one shell from the material examined. The ribs on the left valve only of each pair were counted. Since the number of ribs on the two valves can only differ by a maximum of one, otherwise they would not close properly, and the chances of the left or right valves having the more ribs appears to be about equal; Musio (1930) and Jayakar (1962) suggested that on average the right valve had more ribs, whereas Slijper (1926–1929) suggested the reverse was true.

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The student t test was used to test for the significance of the difference between two mean rib numbers. Its use is justified by the apparent approximation of the distribution of the number of ribs about their mean value to a normal distribution (George, 1949).

In fact the distribution is discontinuous and, therefore, not normal but binomal with a P value of approximately 0·5, to which the t test is equally applicable if the sample numbers are high (Bradbury, verbal communication).

RESULTS

The mean rib numbers of samples of *Cardium edule* and *C. glaucum* originating from homogeneous populations were often very similar but those of *C. glaucum* showed the greater variation (Table 1). Samples from the more exposed sandy habitats (Arcachon, Weymouth and Littlestone) had a higher mean rib number than those from the sheltered muddy habitats (Portsmouth and Chichester harbours). The variation between different populations of *C. glaucum* could not be related to any of the environmental parameters measured. The variation in the number of ribs about the mean differed between populations in both species but there appeared to be little overall difference in this factor between the species; the difference between the maximum and minimum number of ribs in any given population varied between about ±2·5 and ±4 and the overall range in the number of ribs was between 20 and 28 in *C. edule* and between 18 and 32 in *C. glaucum*.

In mixed populations, containing various proportions of the two species, the mean rib number for the specimens of *C. glaucum* was consistently and significantly less than that for those specimens of *C. edule* from the same sample (Table 2). Within each of the cockle populations at Vellerup and Pughavn the species were distributed such that there was an area where both species lived together and another occupied only by *C. glaucum* (at Vellerup) and by *C. edule* (at Pughavn). The mean rib numbers of both species in a mixed population and in isolation could thus be compared in order to determine which species altered its rib number in the presence of the other species. From Table 3 it is evident that the mean rib number in *C. edule* remained unaltered in the presence of *C. glaucum* (Pughavn data) whereas that of *C. glaucum* was significantly lower in the presence of *C. edule* (Vellerup data).

TABLE 1

Mean rib number in *C. edule* and *C. glaucum* from homogeneous populations.

Species	Origin of sample	Mean rib number	(no. counted)
C. glaucum	Spezia (Italy)	20·8	(52)
	Orford, Pool 0	21·2	(82)
	Widewater	22·7	(266)
	Tollesbury	23·2	(30)
	Etang de l'Arnel (France)	23·4	(82)
	Orford, Pool 6	23·9	(46)
	Holkham	24·2	(45)
	Cuckmere	24·5	(80)
	Wells	25·1	(48)
	Horsea	27·2	(49)
C. edule	Langstone harbour	22·5	(50)
	Portsmouth harbour	23·0	(56)
	Farlington	23·1	(50)
	Chichester harbour	23·3	(108)
	Fyns Hoved (Denmark)	23·7	(63)
	Shoeburyness	23·9	(100)
	Whitstable	24·2	(100)
	Littlestone	24·4	(70)
	Weymouth	24·6	(97)
	Arcachon (France)	25·6	(37)

TABLE 2

Mean rib number in *C. edule* and *C. glaucum* from mixed populations.

Origin of sample	Mean rib number (no. counted) *C. edule*		*C. glaucum*		Significantly different at P less than
R. Roach estuary	22·24	(62)	20·58	(62)	0·001
R. Crouch estuary	23·44	(35)	21·79	(65)	0·001
Pughavn	24·04	(57)	23·28	(48)	0·05
Ørø	24·62	(50)	23·04	(50)	0·001
Vellerup	24·10	(70)	22·30	(162)	0·001
Nykobing	23·75	(20)	22·04	(46)	0·001
Lynaes	23·75	(30)	23·12	(36)	0·05
Jaegerspris	24·25	(46)	22·91	(30)	0·001

TABLE 3

Mean rib number in *C. edule* and *C. glaucum* in unispecific and mixed populations at Pughavn and Vellerup.

LOCALITY	SITE	POPULATION COMPOSITION	MEAN RIB NUMBER (NO. COUNTED)	SIGNIFICANTLY DIFFERENT AT P LESS THAN
Pughavn	A	Only *C. edule*	23·68 (63)	no sig. difference
	B	Both *C. edule*	24·04 (57)	0·05
		and *C. glaucum*	23·28 (48)	
Vellerup	A	Both *C. edule*	24·11 (70)	0·001
		and *C. glaucum*	22·60 (162)	0·001
	B	Only *C. glaucum*	23·56 (50)	

TABLE 4

Mean rib number in *C. edule* and *C. glaucum* from the unispecific and mixed components of the cockle population at the Fleet.

SITE	POPULATION COMPOSITION	MEAN RIB NUMBER (NO. COUNTED)	SIGNIFICANTLY DIFFERENT AT P LESS THAN
A	Only *C. glaucum*	23·13 (84)	0·001
B	Only *C. glaucum*	24·22 (108)	0·001
C	Only *C. glaucum*	24·82 (190)	no sig. difference
D	Only *C. glaucum*	25·00 (196)	0·001
E	Both *C. glaucum*	24·18 (164)	0·01
	and *C. edule*	24·64 (66)	no sig. difference
F	Only *C. edule*	24·46 (172)	

To elucidate this phenomenon further, the changes in the mean rib number in *C. glaucum* within the cockle population at the Fleet were studied (Table 4). The sites (A–F) from which the cockles were collected formed a series from the upper end of this lagoon (A) to its narrow connection with Weymouth Bay (F). Environmental data showed that salinity, exposure and substrate particle size increased when proceeding from A to F and none of the parameters measured had a peak high or low value at E. Thus the trend of increasing rib number in *C. glaucum* (sites A–D) appeared to be reversed by the presence of *C. edule* at site E; the mean rib number in *C. edule* remained almost unaltered in the presence of *C. glaucum*.

In order to determine whether the proportion of *C. edule* in a given cockle population influenced the mean rib number in *C. glaucum*, it was necessary to sample from a mixed population in which the proportion of each species gradually changed from 0 to 100%. The cockle population at Lille Strand was most suitable since it was both extensive and consisted mainly of a mixture of both species, *C. glaucum* predominating (100%) at the inner end of the fjord and *C. edule* (97%) at its outer end. Because of the relatively small numbers of each species which could be collected from sites where the other species predominated, the samples were grouped according to the proportion of *C. glaucum* in the sample and the mean rib number calculated for that species in each group (Table 5). The mean rib number for the three groups of *C. edule* shells were 23·68, 23·96 and 23·66, the differences being insignificant. Thus although the average number of ribs in *C. edule* remained almost constant that in *C. glaucum* decreased as the proportion of *C. edule* in the population increased.

TABLE 5

Mean rib number in *C. glaucum* compared with the proportion of that species in the cockle population at Lille Strand (Denmark).

GROUP NUMBER	PERCENTAGE OF *C. glaucum* IN THE SAMPLES	MEAN RIB NUMBER	(NO. COUNTED)
1	>95	24·67	(216)
2	<95 but >60	23·33	(259)
3	<60	22·36	(175)
		Significantly different at P less than 0·001	

DISCUSSION AND CONCLUSION

The significant differences between the mean rib number in *C. edule* and that in *C. glaucum* originating from mixed populations conflicts directly with the results of Eisma (1965), who found no difference between the mean number of ribs in *C. edule* and *C. edule* var *lamarcki* (= *C. glaucum*) contained in four mixed samples. However, of these four samples, one originated from an inland water in Zeeland in which *C. edule* would not be expected to be found living (Russell, 1971), one consisted of shells taken after death and it is not certain whether either of the other two samples were taken alive. Thus it is possible that none of the said samples ever existed as a living assemblage of the two species. If the relationships obtained by Eisma (1965) between mean rib number and average environmental salinity and between the percentage *C. edule* var *lamarcki* in the samples and salinity are compared, a strong correlation between a lower mean rib number and the occurrence of *C. glaucum* in the sample is clearly evident. The poor development of the posterior ribs in *C. glaucum* (Høpner Petersen, 1958) together with the forementioned difficulty of counting the ribs on dry valves may in part account for this correlation. It is, therefore, suggested that the relationship between mean rib number in *C. edule* and salinity resulted from the inclusion of data both from wet and dry material and, more important, from two different species and is, therefore, not strictly valid; this has been confirmed by Wolff (personal communication).

Eisma (1965) cited many authors whose results appeared to substantiate his conclusions; however, the works of Bateson (1889), Musio (1930), Kaltenbach (1934) and Boettger (1950) were based on *C. glaucum* (Russell, 1971) and Purchon (1939) and probably both Jaeckel (1951) and Remane (1958) studied a mixture of samples, some composed of *C. edule* others of *C. glaucum*, consequently their results should not be interpreted as being appropriate for substantiating the relationship between rib number in *C. edule* and environmental salinity. The rib counts reported by Loppens (1923), who like Eisma was aware of an 'elongated form of C. edule' (= C. glaucum) but did not recognise its specific status, are of interest since they support the view that, in general, *C. glaucum* tends to have fewer ribs than *C. edule*, despite the fact that the former species can be found in both very low and very high salinity environments. However, it has been shown that populations of *C. glaucum* can exhibit a mean rib number as high as 27·2. The present data clearly support the view that rib number should not be used as a taxonomic character as was done by Kaltenbach (1943), whose observation that *C. bengasiensis, C. edule paludosa* and *C. coefiensis* (all = *C. glaucum*) had different mean rib numbers in the same locality and that one species had the same rib number in 18 and 37°/oo salinity demonstrates very clearly the variability of rib number in *C. glaucum.*

The differences between the mean rib numbers of homogeneous populations of both *C. edule* and *C. glaucum* were often significant, a feature previously noted in *C. edule* by Jayakar (1962), who concluded that since there was no difference in the mean rib number of samples from different year classes (Walton, 1919 and Purchon, 1939), there was no tendency towards selection for any particular rib number, the variation in mean rib number being due to the environment and not to genetical differences. This suggestion certainly cannot be refuted from the present results obtained from homogeneous populations of either species since, although mean rib number in *C. glaucum* could not be correlated with any of the environmental parameters measured, in *C. edule* the average number of ribs appeared to be related to the degree of exposure of the habitat. Some of the results obtained from different populations of *C. edule* by Slijper (1926–1929), Purchon (1939) and Eisma (1965) support such a correlation.

However, the situation is very different when considering the mean rib number of those populations of *C. glaucum* which share the substrate with *C. edule*. The consistent significant reduction in the mean rib number under these circumstances must be the result of a selection pressure against those cockles having a high rib number, thus accentuating the difference between the species, and it is suggested that this feature is evidence of 'character displacement' (Brown and Wilson, 1956), *C. edule* being the sibling species. The taxonomic history of *C. glaucum* exhibits certain features in common with other species displaying character displacement. Kohn and Orians (1962) cited an example in the Redwing (*Agelaius phoeniceus*), which due to a conspicuous plumage displacement when the range of these birds overlapped with that of the sibling *A. tricolor*, led to the erection of a new species (Audubon, 1842), which although invalid survived in the literature for more than 50 years (Mailliard, 1910). Such marked displacement is not evident in *C. glaucum* but it has led to the erection of an invalid species. Reeve (1845) separated *C. lamarcki* from *C. belticum* Beck using the differences in shape of their shell; although these differences are probably environmental modifications, displacement of the ligament length/shell width relationship (Høpner Petersen, 1958) is evident in *C. glaucum* from mixed populations (Russell, 1969). Later Johansen (1918) separated them subspecifically, using the name *C. edule* var *inflata* Mörch for *C. glaucum* from areas where its range is now known to overlap with that of *C. edule* and *C. edule* var *baltica* Beck for that species from areas where *C. edule* is now thought to be absent (Russell, 1971); Winckworth (1932) used the name *C. edule lamarcki* and *C. edule beltica* for these cockles, thus giving each equivalent status to his *C. edule edule*. It was not until as recently as 1958 that Høpner Petersen amalgamated these two forms under the name *C. lamarcki* (= *C. glaucum*), which he separated from true *C. edule*.

The displaced character in the male Redwing is of obvious significance in selective mating, favouring the individuality of the siblings as opposed to hybridisation. However, in *Cardium* species, in which random fertilisation may be assumed, the significance of a reduction in rib number must be assumed to be the result rather than the cause of continued genetic isolation. Since the number of ribs on a cockle shell, so far as is known, has little or no physiological or ecological significance then it must be assumed that it is linked to some factor which does have such significance and upon which selection could act. Cockles having shell characters intermediate between *C. edule* and *C. glaucum* (hybrids?) have been observed by Eisma (1965) and Russell (1969), invariably in areas where there is a broad zone of overlap (Russell, 1971); however, Høpner Petersen (1958) did not record intermediates from some Danish fjords. Crossfertilisation between the species has been demonstrated in the laboratory with some hybrid larvae reaching metamorphosis (Kingston, verbal communication). The significance of this is doubtful since the forementioned author has reared only *C. glaucum* to metamorphosis. However, it has been shown that *C. edule* spawned some weeks before *C. glaucum* in a mixed population in the River Crouch estuary (Boyden, 1971); although the spawning times of isolated homogeneous populations often coincided (Kingston, verbal communication). Consequently it has been suggested that a higher temperature may be required to initiate spawning in *C. glaucum* (Russell, 1971).

It is possible, therefore, that a low rib number may be linked with a high temperature threshold for spawning. It is of course possible that the rib number displacement results directly from the development of larvae in environments with high water temperatures. However, this seems unlikely since an inverse correlation between mean rib number in *C. glaucum* and summer water temperature should be evident; neither the present results nor those of other workers (e.g. Slijper, 1926–1929 and Eisma, 1965) suggest that samples of *C. glaucum* from Mediterranean water have on average fewer ribs than those from Atlantic or Baltic waters. Thus, in conclusion, it is suggested that although the number of ribs in both *C. edule* and *C. glaucum* may be controlled to a large extent by the environment and thus should not be used as a taxonomic characteristic, the rib number displacement exhibited by *C. glaucum* in the presence of the sibling species *C. edule* is very strong evidence for the acceptance of *C. glaucum* as a valid species, distinct from *C. edule*; a problem that has troubled many eminent conchologists for some 200 years.

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J. Conch. **27**: 410 (1972)

REVIEWS

Holden Clough the natural history of a small Lancashire valley. Pp. 1–199, numerous illustrations. 1971. Paperback. Oldham Public Libraries, Art Gallery and Museum. 50p. post free.

This most attractive production deals with, as the title states, the natural history of a small Lancashire valley. The valley studied lies in industrial Lancashire, between Oldham and Ashton-under-Lyne, at about 450′ O.D. and 26½ acres of its total area of 36 forms a nature reserve. The clough's fauna and flora are in a sense "relict", comprising species once much more widespread in south-east Lancashire.

Such local faunas are often unbalanced, in that such popular groups as birds and lepidoptera are well covered, but many invertebrate groups are dismissed very perfunctorily. This is not the case in *Holden Clough . . .* where all the phyla, from mammals to rotifers are well treated and the botanist is also well catered for. It is pleasant to note that an energetic member of the Conchological Society, Mr. W. F. Edwards, has contributed a list of 39 species of Mollusca (on pp. 187–190), two of them confirmations of Fred Taylor's 1897 records. A combination of boulder clay, no lime, and industrial Lancashire is not encouraging to Mollusca and Mr. Edwards' list represents much hard work and shows what can be found in a small area in what most conchologists would regard as extremely poor ground. The molluscan pages are prefaced by a fine drawing of a rampant *Arion ater*, and there are also photographs of *Discus rotundatus* and *Arion ater* (why is *A. ater* honoured with two representations?).

The volume is well illustrated with photographs and line-drawings; some of the former are not very clear but the line-drawings are excellent. A most attractive stiff paper cover completes a production of which Oldham may well be proud.

N. F. McMillan

Terrestrial Slugs. By N. W. Runham and P. J. Hunter. Hutchinson University Library, 1971. Price £2 cased and 80p. paper.

This book is a review of research papers on a wide selection of topics concerning pure biological and applied research on British terrestrial slugs. Foreign slugs, e.g. *Vaginulus* from families not represented in the British Isles are mentioned in the introduction and section on classification and, occasionally, elsewhere in the text. The eight chapters include classification; food, feeding and digestion; metabolism, respiration, breathing, circulation, blood, water relations and excretion; reproduction, development, growth and genetics; locomotion, mucus, sensory structures, nervous system, endocrinology; ecology and slugs as pests. The text is illustrated with 6 black and white plates, 39 figures and line drawings and several tables of data. An indication of scale would have been helpful in some of the drawings, e.g. Fig. 29 showing cells of the digestive gland. The book is concluded by 20 pages of references including some very recent papers and also work of Continental and American authors. It is a useful list and one is pleased to see the titles written in full.

One point which strongly emerges from this book is the interim nature of slug research as a whole and the need for more work to fill in the general picture. As a result some sections are heavily biased towards a few specific examples rather than a comparative approach. The book is interesting and, as a source of existing information, aims to stimulate further research. It is written for university undergraduates, teachers and research workers and indicates the role of slugs as pests in agriculture as well as a source of material for teaching purposes.

J. E. Chatfield

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NOTES ON THE OCCURRENCE OF *VERTIGO GEYERI* LINDHOLM IN IRELAND

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The species now living in Ireland is *Vertigo geyeri* Lindholm, which can be separated from the closely allied *Vertigo genesii* Gredler (Gredler, 1856), a common species of certain post-glacial deposits in Britain, by the presence of apertural denticles (Lindholm, 1925; Ehrmann, 1933 : p. 43, fig. 22).

The first record of *Vertigo geyeri* in Ireland can be found in a paper by A. W. Stelfox (1925). In this paper he reports finding in a marl at Golden Grove, near Roscrea, Co. Offaly (King's Co.), (S 1291), specimens of both a toothed and a tooth-less form of *Vertigo genesii*. The former is now referable to *Vertigo geyeri*. R. A. Phillips also reported the finding of a single recently-dead shell of the dentated form in June 1924, some four months after the discovery by Stelfox, from a marshy spot near Mountmellick, Co. Leix (Queen's Co.). The first living specimens to be found in Ireland were then procured by Phillips from this locality after a careful examination of the area in September of the same year. Phillips subsequently examined a large number of similar sites on the central plain, and over the years several new localities for the species were recorded:— Fiagh Bog, October 1931; Pollboy Bog, September 1933; Cloonascragh Bog near Tuam, October 1933; Roscrea "Summerhill", August 1934; and Rathdowney, September 1937 (Phillips, 1935). The known distribution of the species then remained unchanged until its discovery by Dr. G. Visser in Newbridge Fen, Co. Kildare in 1969. During the intervening years there has been little information on the environmental changes taking place at these localities, and at the beginning of 1970 the known status of the species was based almost entirely on the information provided by Phillips in published or manuscript form.

In August 1970, and again in March 1971, it became possible to re-examine a number of these localities, and this account records the present status of the species, and attempts to assess the relationship between the species and its environment.

The Sites

Mountmellick, Co. Leix. (N 40)

The exact position of Phillips' site at Mountmellick is not clear and it is therefore difficult to make an assessment as to its present status. An examination of the area around Mountmellick was made on two separate occasions, but no possible sites could be located. During the years in which Phillips was working on the distribution of this species, and determining the flora and fauna of the various localities, he made no reference to this site in his notebooks, which suggests that it may have been lost by drainage, or some other physical change, soon after his initial visit. The area was described by him as a narrow strip of wet ground cut off from a damp natural meadow by a drain, and covered by a dense growth of moisture-loving plants.

Fiagh Bog near Borrisokane, Co. Tipperary. (R 952976).

Fiagh Bog is situated three miles north-east of Borrisokane and covers an area of about one square mile. The area is of a true fen character, and very rich in plant and animal life. Two areas of the bog were examined: one situated by the side of the road which runs across the bog from Aglish to Borrisokane, the second at the edge of the bog to the south-west of the road from Aglish to Ballingarry. The first site proved to be very rich in mollusca, but no specimens of *Vertigo geyeri* were located. The second produced a small scattering of specimens in a sample of herbage removed for examination. This sample, which weighed 2·75 Kg, yielded 156 individual specimens of mollusca of 13 species, as listed in table 1.

The status of the area as a permanent habitat is questionable due to the draining of a marsh a little to the south-east, which may lower the water-table and render the area too dry.

Pollboy Bog near Ballinasloe, Co. Galway. (M 8628).

Since 1952 Phillips' site at Pollboy Bog has been completely changed, due to the water-table being lowered by about four metres for peat cutting purposes.

**Cloonascragh Bog near Ballinasloe, Co. Galway.* (M 874261).

Situated about two miles SSE of Pollboy Bog, this locality may be regarded as an extension of the last site. The fen at this point has been formed by an area of water which is trapped between the raised surface of the bog and an esker. The area is very rich in plants. The dominant species is *Juncus acutiflorus* Hoffman, a rush typical of acid marshes and bogs. A sample of herbage was taken from an area of about one square metre, as were all the samples taken from the various localities yielding *Vertigo geyeri*. This sample weighed the same as that from Fiagh Bog, (2·75 Kg), and produced 629 individual specimens of mollusca of some 13 species. Nearly half (313 individuals) proved to be *Vertigo geyeri*, represented by 241 adults and 72 juveniles.

This area at the moment seems to be fairly safe, but only time will tell what effect the draining of Pollboy Bog to the north will have on the local water-table.

Cloonascragh Bog near Tuam, Co. Galway. (M 4348).

This site appears not to have been visited by any conchologist since Phillips' last

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* In Galway the name Cloonascragh is a gaelic word meaning the meadow of the sand ridge.

TABLE 1

List of the species of mollusca found in association with *Vertigo geyeri*.

Site	A.	B.	C.	D.	E.	F.	G.	H.	J.
Carychium minimum Müller	x	19	x	125	x	x	228	x	x
Lymnaea truncatula (Müller)	x	x	x	–	–	–	33	–	x
L. palustris (Müller)	–	13	–	16	–	–	–	–	x
Planorbis carinatus Müller	–	–	–	2	–	–	–	–	–
P. crista (L.)	–	4	–	–	–	–	–	–	–
P. contortus (L.)	–	8	–	3	–	–	–	–	–
Catinella arenaria (Bouchard-Chantereaux)	–	x	–	–	–	x	–	–	–
Succinea pfeifferei Rossmässler	x	8	x	33	x	x	10	x	x
Cochlicopa lubrica (Müller)	x	x	–	–	x	x	34	x	x
Columella edentula (Draparnaud)	–	x	x	–	x	–	–	–	x
Vertigo antivertigo (Drapernaud)	x	42	x	37	x	x	27	x	x
V. substriata (Jeffreys)	x	–	x	–	x	–	–	x	x
V. pygmaea (Draparnaud)	x	x	x	–	x	–	2	x	–
V. geyeri Lindholm	x	5	x	313	x	x	55	x	x
V. moulinsiana (Dupuy)	x	1	–	–	–	–	–	–	–
Lauria anglica (Wood)	x	x	–	–	–	x	–	–	x
Vallonia pulchella (Müller)	x	–	x	–	x	x	47	–	x
Hygromia hispida (L.)	x	x	x	–	–	–	–	–	x
Punctum pygmaeum (Draparnaud)	x	x	–	14	–	x	27	x	x
Arion ater agg.	–	x	x	–	–	–	–	–	–
Euconulus fulvus (Müller)	x	5	x	35	x	x	75	x	x
Vitrea crystallina (Müller)	x	–	x	–	x	–	18	–	–
Retinella radiatula (Alder)	x	x	x	4	x	x	16	x	x
Zonitoides nitidus (Müller)	x	37	x	–	–	x	80	x	–
Agriolimax laevis (Müller)	x	5	x	1	–	x	1	–	–
Pisidium casertanum (Poli)	–	–	–	–	–	–	1	–	–
P. personatum Malm	–	–	–	42	x	–	–	–	–
P. obtusale (Lamarck)	–	7	–	–	–	–	5	–	–
P. milium Held	–	2	–	4	–	–	–	–	–

Site A. Mountmellick, Co. Leix
B. Fiagh Bog near Borrisokane, Co. Tipperary.
C. Pollboy Bog near Ballinasloe, Co. Galway.
D. Cloonascragh Bog near Ballinasloe, Co. Galway.
E. Cloonascragh Bog near Tuam, Co. Galway.
F. Roscrea "Summerhill", Co. Tipperary.
G. Near Roscrea, Co. Offaly.
H. Rathdowney, Co. Leix.
J. Newbridge Fen, Co. Kildare.

Note:
x = species previously recorded.

known visit to the area on Sunday, 30th August 1936 (Phillips MS), when he recorded this species as being plentiful. The habitat is described by him as being a marshy spot where the edge of the bog meets the base of an extensive esker, at a point two miles south of Tuam. Additional to this reference is a statement in his notebook for the 8th October 1933, where he states that the site is near to the golf links. Modern maps however show the links to be one mile to the *north* of Tuam, which suggests that the area of the links, and possibly the bog, may have been sold for agricultural or other commercial purposes. This would almost certainly mean the draining or general destruction of the habitat.

This habitat must have been very similar, in many of its aspects, to the site at Cloonascragh Bog near Ballinasloe, as described above.

Roscrea "Summerhill", Co. Tipperary. (S 1090).

The site at Roscrea from which Phillips recorded *Vertigo geyeri* was situated about two miles north-west of the town in a small wet field by the side of the Birr railway. Phillips in his MSS notes for the 13 February 1935 uses the name Summerhill to place the locality, therefore this name has been used to distinguish this site from the following. The habitat was situated between the railway embankment and nearby hilly pasture-land, the area being curtailed and much interfered with by the grazing and trampling of cattle (Phillips, 1935). No visit was made to this locality by ourselves, and therefore its present status cannot be assessed, but it would seem probable that this site, or a similar one very close by, should still be in existence.

Roscrea, Co. Offaly. (S. 163903).

The marshy area near Roscrea from which we recorded this species is situated in a hollow between a series of small drumlins on the north side of the railway line, two miles north-east of the town, and about two hundred yards from the main road. The sample of herbage taken weighed 4.55 Kg, (The extra weight of this sample was mainly due to the highly calcareous nature of this habitat, producing tufaceous crusts on the vegetation.), and produced a total of 695 individual specimens of mollusca, of some 16 species; 55 specimens proved to be *Vertigo geyeri*.

This site is perhaps the safest, in the long term, of all the known habitats of this species, due partly to its small size, but also because of its very low lying position relative to the surrounding countryside.

Rathdowney, Co. Leix. (S 2978).

Two specimens of *Vertigo geyeri* were recorded by Phillips from a marshy area about one mile to the east of Rathdowney, (Phillips MS). The exact position is not known, and it is therefore difficult to be conclusive as to the status of this record. A brief examination of a marshy area near Rathdowney in March 1971, failed to produce any specimens.

Newbridge Fen, Co. Kildare. (N 7715).

Newbridge Fen is a very large marsh situated in low-lying land two miles west of Newbridge (Droichead Nua). Dr. G. Visser, who discovered *Vertigo geyeri* at this locality in 1969, describes the area as a large calcareous bog which has been almost completely destroyed by drainage. A visit was made in March 1971 in the hope of locating the area from which Dr. Visser took his specimens, but even at that time of the year it proved very difficult to locate an area of the bog that had a covering of surface water. This site therefore must be regarded as being lost due to drainage.

Nature of habitats

A careful examination was made of the samples of herbage in which *Vertigo geyeri* was located, and a list of the species found in association was kept. In order that the samples would be of some scientific use the same method of sampling was used at each of the sites, and the same volume of herbage was removed. A list of the plants thus recorded can be seen on table 2. It will be noticed from this table that in no case did we record the same species of plant at all three stations, (It must be noted that a number of unidentifiable plants, mainly grasses, occurred in the samples.), and this fact led to an examination of the physical habitat preferences of the plant species, notably a preference for alkaline or acid habitats. The results proved interesting due to the mixture of species normally regarded as having distinct and opposite habitat preferences, (McClintock & Fitter, 1956; see table 2). A fuller and more comprehensive list of the plant species found at each locality can be found in Phillips (1935), and in his MSS. notes.

Samples of water taken from the three sites were analysed, and the results compared with typical figures obtained from oligotrophic peat-bog water, and from water derived from Carboniferous Limestone. From these figures it was found that the water taken at each of the localities gave readings approximately halfway between that of the peat water and the limestone derived water, (see table 3). This would suggest a rather narrowly defined chemical environment, neither strongly acid nor alkaline.

The exact habitat preference of *Vertigo geyeri* in Ireland is still not fully understood, but the results of the notes made both by Phillips and ourselves tends to lead to the conclusion that this species is restricted firstly to areas of very wet fen with a fairly stable water-table, and that furthermore the surface water must be of a fairly neutral character. The fen must have a luxuriant growth of narrow leaved plants, ie, grasses, sedges or rushes, or a mixture of all three, and be free of *Sphagnum* mosses.

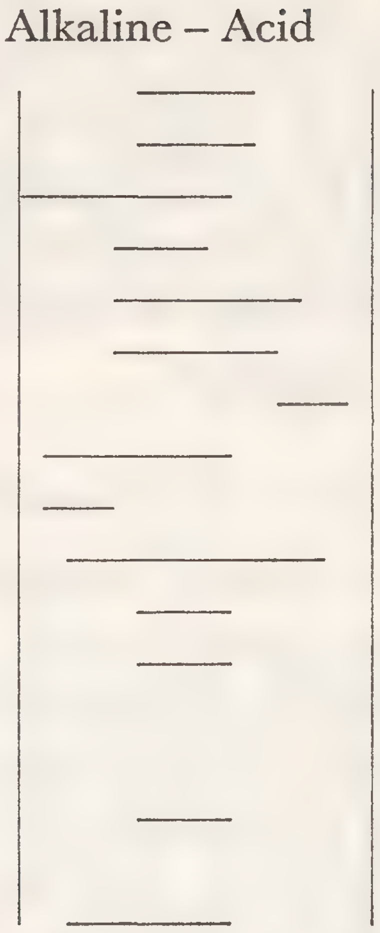
CONCLUSIONS

The draining of many of the marshy areas on the central plain of Ireland must have limited the number of suitable sites for *Vertigo geyeri* still undiscovered, and the results of our work has shown that at least some of the known localities have

TABLE 2

List of the plants recorded from the samples of herbage.

Site	B.	D.	G.
Caltha palustris L.			x
Ranunculus flammula L.		x	
Parnassia palustris L.		x	
Angelica sylvestris L.			x
Menyanthes trifoliata L.			x
Cirsium dissectum (L.)		x	
Juncus acutiflorus Hoffmann		x	x
Schoenus nigricans L.	x		
Carex lepidocarpa Tausch			x
Phragmites communis Trinius	x		x
Equisetum variegatum Weber & Mohr			x
E. palustre L.			x
Mosses			
Drepanocladus revolvens v. *intermedius* (Lindb.) Rich. & Wall.			x
Campylium stellatum (Hedw.) J. Lange & C. Jens	x	x	



Site B. Fiagh Bog near Borrisokane.
D. Cloonascragh Bog near Ballinasloe.
G. Roscrea.

TABLE 3

Chemical Analyses	Site B.	Site D.	Site G.	Oligotrophic peat bog water	Water from Carboniferous limestone
pH.	7·6	7·5	7·3	5·0–6·5	7·0–8·0
Total hardness as $CaCO_3$ p.p.m.	230	200	280	60–70	300–350
Conductivity micromho	440	250	410	*variable	400–500

* Dependent on dissolved organic salts, can be as low as 70.

been lost. Of the three areas in which we found living specimens, in two cases the local water-table has been, or is being lowered, although as yet this has not affected the habitat. The third, situated on agricultural land, is always likely to be destroyed. The future existence of this species as a member of our native fauna must therefore be in danger, and unless some measure is taken fairly soon to protect and maintain one of the remaining known habitats, it may not be all that far in the future when we see the last of this interesting glacial-relic species.

ACKNOWLEDGMENTS

The authors would like to thank all those who have helped with the preparation of this paper. These include Dr. G. A. Nelson who identified all the flowering plants, and Mrs. M. Dalby who identfied the mosses. Dr. F. H. Perring and Mr. R. McMullun who gave advice on the distribution of certain plant species, and helped in the plotting of possible sites for *Vertigo geyeri*. We would also like to thank Mrs. M. Fogan, Mr. R. Croome, Dr. C. S. Woods and Mr. C. R. C. Paul for their help in locating and examining the sites. Special thanks are also due to Dr. M. P. Kerney without whose help, advice and encouragement none of the above work would have been done.

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J. Conch. **27**: 418 (1972)

REVIEW

Seashells by S. Peter Dance (Hamlyn All-Colour Paperback Series) 1971. 40p.

In opening a book on the Mollusca by Mr. Dance the reader has the advantage of knowing that he is going to get facts accurately stated, and correct and consistent nomenclature without any frills or confusion. The present book makes little or no attempt to help the beginner who wants to name his newly-acquired shell collection; rather it is an ideal starting-point for anybody who has just fallen under the spell of conchology and wants to know where to start. A bird's-eye view of the whole phylum is provided: each of the main shell families is dealt with and a successful attempt has been made to show how it fits into the overall pattern of the Mollusca. Most of the well-known stories about individual shells are re-told, together with a few new ones: this is good because the tyro is sure to come across them some time and might as well have them at once and accurately stated. The sense of wonder is thereby stimulated and Mr. Dance's enthusiasm is infectious, even if it does trap him into calling *Cypraea leucodon* Broderip "one of the world's most valuable objects". About *Argonauta* he is less keen: its so-called shell "is nothing more than an egg-case secreted by the female's two flat arms". Surely he means "nothing less than . . ."?

It is a pity that, presumably because of an editorial policy, the book is pervaded by a form of metrication. We are of course, long used to shells in centimetres in general terms, but even the British fathom has disappeared and to read of a small shell 0.2 cm. long is very interrupting to the train of thought. Uniformity can be overdone.

Illustrations are excellent and bring out the character of the shell. Not all illustrators have this gift, so necessary for easy identification. The colouration is most attractive but remains very reasonably true to nature—a thing not easily done when the artist is faced by the subtle shades of families like the cowries.

The book provides good hints on the best ways of collecting, preserving and storing shells of all kinds, and many facts about the impact of the Mollusca on human life, either as blessing or curses or ever-filled purses. Wampum, incidentally, was not made by stringing together valueless pieces of waveworn *Mercenaria* but by shaping the shell fragments into pierced drum-shaped beads of identical size: it was the hours of patient toil which gave value to the result and made it usable as currency.

The book does more than marshall the same old facts and present them again: care is taken to give full attention to the less well-known families which are so often ignored and therefore present a greater puzzle to the beginner. There is also much that is new; the book may be called a veritable mind of facts and seems excellent value.

T. E. Crowley

J. Conch. 27: 419–421 (1972)

AGRIOLIMAX CARUANAE POLLONERA AND OTHER NON-MARINE MOLLUSCA IN FAROE

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(*Read before the Society, 20 March 1971*)

Faroe is not very often visited by conchologists and therefore an account of a ten days' visit there in July 1970 may be of interest, and serve also to record an addition to the non-marine Mollusca of the islands.

The Faroe islands, with an area of about 540 sq. miles, lie out in the Atlantic between Iceland and Shetland. There are about twenty islands, seventeen of them inhabited. Most of the land lies between 1,000 ft. and 2,500 ft., rising precipitously from the sea in great cliffs terraced by the rocky ledges formed by the exposed edges of successive lava-flows, for only igneous rocks are present. Every cliff is hung with innumerable waterfalls, there is plenty of peat, and the title of the "storm-swept Faroes" is not undeserved.

With a national economy based on fishing, every town and village (with one exception) is sited at the edge of the sea. Such farming as there is, is on a very small scale; six cows are considered a sizeable herd, and hay is scythed and dried on wire fences as in Norway. Minute potato-patches cling to near-vertical slopes and other field-crops are conspicuous by their absence. The older houses are roofed with sods, green with grass and yielding a hay-crop regularly.

All in all, the islands are not encouraging places for non-marine Mollusca; during my ten days' stay I only managed to find fourteen species (nine of them slugs). Most of these were taken about the outskirts of the capital Thorshavn, but a day was spent on the island of Sandoy and two on Nolsoy, Sandoy is almost unique in Faroe in possessing sand-dunes and a fine sandy beach, both of dark grey sand. The dunes yielded no molluscs but the beach had a fair variety of marine shells. The island of Nolsoy lies opposite Thorshavn and two days there only produced seven species, six slugs and *Lymnaea peregra*.

There are few previous records of slugs and snails from the islands. Collinge (1904) recorded five species collected by N. Annandale and F. H. A. Marshall in 1900 and 1903. The section on non-marine Mollusca in the *Zoology of the Faroes* was never published although it exists in MS (Steenberg and Mandahl-Barth, 1938). (Dr. Knudsen has recently informed me that an account of the Faroes non-marine Mollusca will soon appear.) Twenty-nine species recorded from the islands are listed by Mandahl-Barth in the *Zoology of Iceland* (part 65, pp. 26–8) without details as to habitat or precise location.

Of these twenty-nine species one (*Arianta arbustorum*) was deliberately introduced, and according to A. E. Ellis (1969 : 277–8) the slugs *Arion hortensis*, *A. intermedius* and *A. ater* have also been introduced. I may say, however, that I found *Arion ater* on wet peaty ground by the river Hoyvicksa, north of Thorshavn, in what looked a most convincingly wild habitat, as well as in disturbed habitats.

LIST OF SPECIES OBTAINED

Lymnaea peregra (Müller). River Sanda, south of Thorshavn and in a pool about half a mile out of town. In a tiny stream on Nolsoy, spawning on 14 July. These specimens were only 4 mm. high. In the lake Sandsvatn on Sandoy, minute specimens (height 4–5 mm.) on 16 July with very numerous empty shells of the same size. A curious habitat was a small shallow pool on the coast just north of Thorshavn. The pool lay among rocks just above high-water mark and was full of a *Potamogeton* sp. (with oval leaves) and numerous *L. peregra* (height 9 mm.).

Lymnaea palustris (Mull.). Thorshavn, a single immature shell (Collinge, 1904). Not refound in 1970.

Arion circumscriptus Johnston s.s. Two small examples *det.* A. E. Ellis, in the old cemetery, Thorshavn.

A. silvaticus Lohmander. Most of the specimens of the aggregate *A. circumscriptus* belonged to this form with white sides and more conspicuous lateral bands. It was fairly common on rough heathy ground around Thorshavn.

A. hortensis Férussac. Quite frequent in the old cemetery and in builders' rubbish, Thorshavn. It was not taken in a satisfactorily "wild" habitat.

A. subfuscus (Draparnaud). About Thorshavn, in several places, and a specimen on Nolsoy.

A. ater (L.) s.l. Ellis (1968 : 278) states that this species has been introduced into Faroe but I found both young and adult specimens almost everywhere. All the adults seen were all-black or black with a grey footsole. While the species could have been introduced with plants (e.g. in the old cemetery) in other places it occurred in fair numbers on peaty ground with *Eriophorum* and *Narthecium* and looked truly native there. On Nolsoy it occurred on the fringe of the village, but on Sandoy I found it on a strip of rough ground beside the lake Sandsvatn, well away from houses. The species is widely distributed in Iceland (Mandahl-Barth, 1938).

Collinge (1904) recorded *A. ater* as "very common" and commented that the genitalia differed from those of the "large black slug common in the British Isles". He also referred to a bicoloured form (which I did not see) and noted that it appeared to occur only in swampy ground outside the cultivated zone around the villages.

Oxychilus alliarius (Miller). Specimens on rough heathy ground were fairly typical, although large, and similar specimens were taken in the old cemetery, Thorshavn. Then some specimens were found on waste ground (and associated with *Agriolimax caruanae*) which seemed much more like *Oxychilus cellarius*. These molluscs possessed no "oniony" smell even when irritated, the soft parts were pale, and the shells larger than undoubted *alliarius* obtained elsewhere. Both Mr. Ellis and Dr. Kerney, however, considered the specimens all *alliarius* and the latter added that he had seen similar specimens from northern Scotland.

Agriolimax laevis (Müller). A single specimen on rough heathy ground outside Thorshavn, and another on Nolsoy.

A. reticulatus (Müller). In the old cemetery and on waste ground about Thorshavn, the blotched or reticulated form. Only one plain cream-coloured specimen was noted. Also on both Sandoy and Nolsoy, the reticulated form.

A. caruanae Pollonera. On waste ground to the west of Thorshavn, apparently frequent (*det.* Ellis). An addition to the fauna of the islands.

Lehmannia marginata (Müller). Nolsoy, several beside rough road up hill. Rough ground, north of Thorshavn. Collinge (1904) stated that his specimens, collected July and August, were all immature, and further, that the species, while not uncommon, occurred chiefly in gardens "and so probably introduced".

Pisidium obtusale (Lamarck). In a shallow wayside pool with *Eriophorum* north of Thorshavn, 18 July 1970.

P. casertanum Poli. With *P. obtusale* (q.v.), and also in a larger pool not far away.

P. nitidum Jenyns. With *P. casertanum* in the larger pool mentioned above. I am grateful to Mr. J. G. J. Kuiper for determining the Pisidia listed.

It might be noted that *Potamopyrgus jenkinsi* (Smith) was not found despite careful search.

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POSTSCRIPT

Since the above was written *The Zoology of the Faroes* Part LVII *Land and Freshwater Mollusca* (by Kare Fog) has appeared. All the species I took are recorded in it, except *Agriolimax caruanae*.

CAPTAIN CYRIL DIVER—ADDENDA

In addition to his published papers on the Studland Heath peninsula (listed on p. 276) Diver had completed, just before his death, three long papers dealing further with the area but considered too long for publication. These form parts of the Studland Heath Peninsula Survey and are as follows: VII, Syrphidae (Diptera); VIII, Mollusca; IX, Fires and Habitat Recovery.

All are in typescript (bound) and are now held at the Nature Conservancy's headquarters at 19 Belgrave Square, London S.W.1.

I am indebted to Mrs. Diver for drawing my attention to these MS. papers.

EDITOR

J. Conch. 27: 423–426 (1972)

SOME FOSSIL MOLLUSCS FROM MURUAROT HILL (TURKANA DISTRICT, KENYA)

D. Van Damme & A. Gautier*

(*Read before the Society, 16 October 1971*)

1. *History and geological context of the collection*

The material described in this paper was collected by the University of California Expedition in 1948 from three localities at Muruarot** Hill (Turkana District, Kenya). According to the latest information available Muruarot 3 coincides with the locality from which C. Arambourg (1933; 1944) described several fossil mammals and dated as Lower Miocene. The adjacent localities Muruarot 1 and 2 are of comparable age. In the same area other fossiliferous sites have been reported possibly dating from the Late Miocene or the early Pliocene (cf. W. W. Bishop, 1968, p. 47).

The beds in which the fossils have been found, belong to "Séries stratoides du Turkana" (Arambourg, 1944). These series have not yet been described in detail, but are mainly composed of vulcanic rocks (tuffs, lavas) and freshwater deposits.

The fossil molluscs are listed under numbers D 4084 to D 4086 (Muruarot 1 to 3) in the Museum of Paleontology, University of California, Berkeley, which institution kindly granted permission for a loan of the material to the authors. Mr. C. Madden, who is now working on the fossil mammals of Muruarot, generously helped with information on the history and geology of the localities. Mr. T. Pain (London) and Dr. B. Verdcourt (Richmond) checked some of our identifications.

2. *Description of the collection*

Lanistes carinatus (Olivier, 1804)
(Pl. XV, fig. 1)

Lanistes carinatus G. Mandahl-Barth, 1954, pp. 49–50, fig. 19

Lanistas carinatus B. Verdcourt, 1963, p. 8, figs. 6, 7 & 8

Material: Muruarot 1, 2 and 3; 29 specimens mostly broken or crushed; measurements of largest specimen: H = 24·0 mm.; D = 32·2 mm. (T121); H = ±29·2 mm.; D = 37·5 mm. (T58).

Remarks: The fossils although falling within the variability range of the recent form, have a low H/D ratio, a very short spire and a broad body whorl. A median carina is sometimes clearly visible. Most specimens show a very pronounced basal angulation around an unusually wide umbilicus. Our material compares very well with fossil *Lanistes carinatus* from Karungu (Lower Miocene, Verdcourt, 1963, fig. 7).

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* Laboratorium voor Paleontologie, Geologisch Instituut, Rijksuniversiteit, Gent.

** Spelling adopted by Walsh and Dodson (1969).

Fossil finds of *Lanistes carinatus* are known from several miocene deposits at Rusinga Island, from Muruarot and other localities in Kenya (Verdcourt, 1963) and from the Lake Albert-Edward rift (Mohari Formation, Kaiso Formation and related deposits; W. Adam, 1959; A. Gautier, 1965, 1970). The oldest known representatives of the genus are from the Lutetian in the Fayum (*Lanistes antiquus*, Blanckenhorn, 1901) and from the Hudi Chert in the Nubian Sandstone (*Lanistes grabhami*, Cox, 1933; Upper Eocene-Lower Oligocene).

Pila ovata (Olivier, 1804)
(Pl. XV, fig. 2)

Pilo ovata subspp. G. Mandahl-Barth, 1959, pp. 40–48, fig. 12–17

Ampullaria ovata B. Verdcourt, 1965, pp. 8–9, fig. 9

Pila ovata S. V. Bell, 1966, pp. 161–163, fig. 1

Material: Muruarot 1, 2 and 3; 21 specimens some of which crushed; measurements of largest specimen: H = 47·1 mm.; D = 37·5 mm.; H aperture = 35·5 mm.; D aperture = ±20 mm. (T322). Four specimens retained their opercula.

Remarks: B. Verdcourt (1963), records *Pila ovata* from Muruarot and other miocene deposits, where it usually has been found together with *Lanistes carinatus.* His specimens from Muruarot are only 25 mm. high and 25 mm. broad. *P. ovata* has been recorded also from the Kaiso Formation and related deposits (Plio-Pleistocene), and the Mohari Formation (Miocene) (Adam, 1959; Gautier, 1965, 1970). *Pila colchesteri* from the Hudi Chert is the oldest known fossil from this genus (Cox, 1933; Eocene-Oligocene).

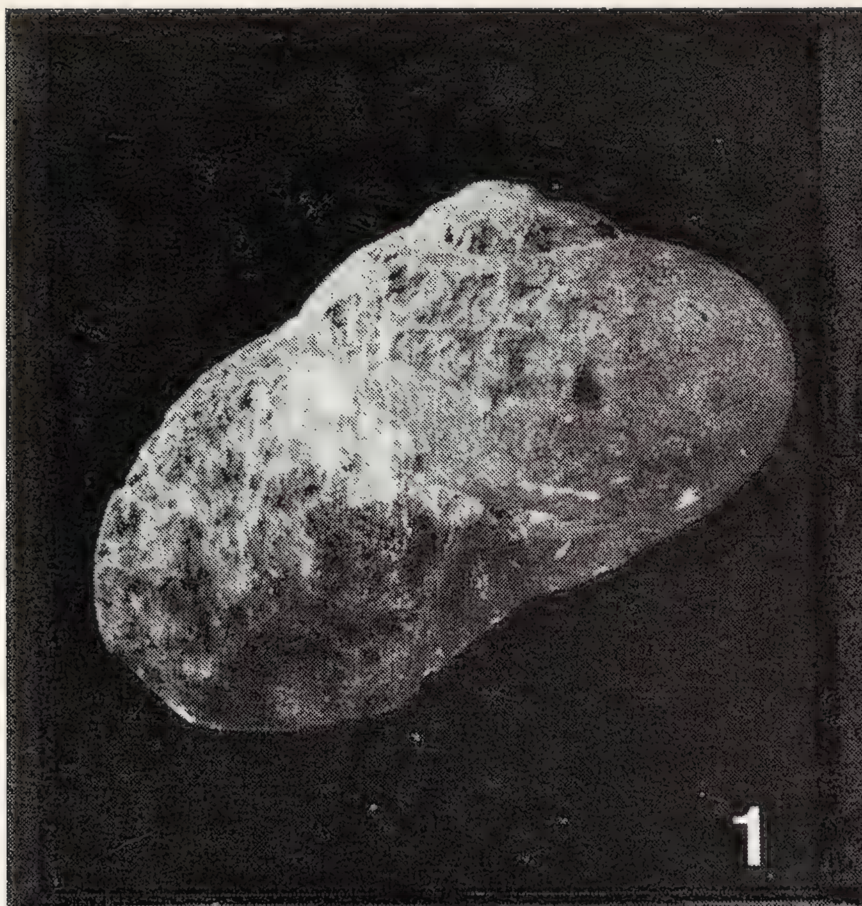
Cerastua miocenica (Verdcourt, 1963)
(Pl. XV, fig. 4)

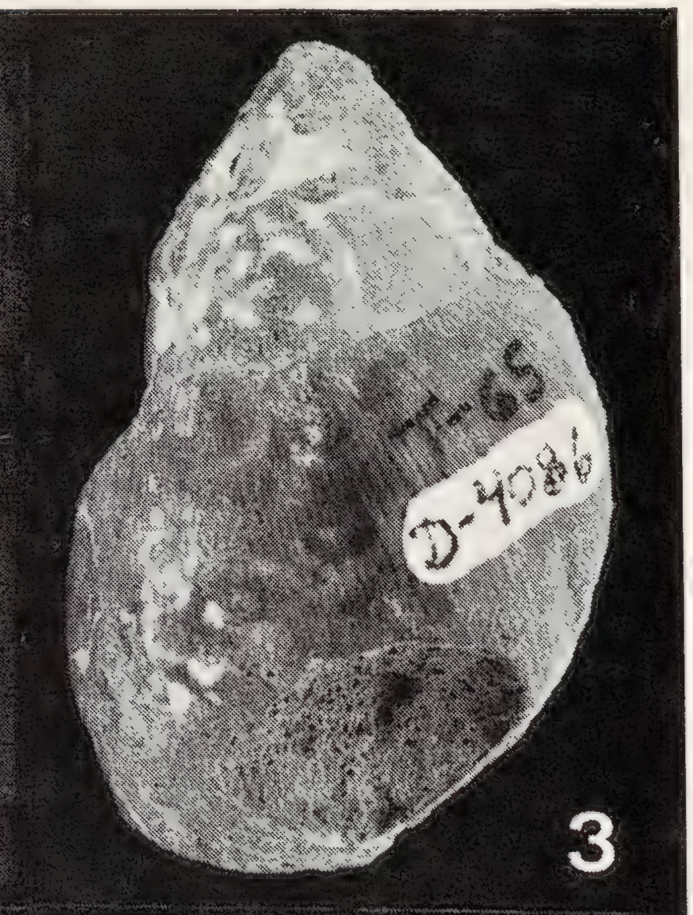
Cerastus miocenicus B. Verdcourt, 1963, pp. 11–12, fig. 16–17.

Material: A somewhat crushed specimen from Muruaot 3; measurements: H = 16 mm.; D = 9 mm.

Remarks: The material was sent to Dr. G. Verdcourt and Mr. Pain who confirmed the identification, although the specimen is not very typical (M. Pain *in litt.*). The genus *Cerastua* Strand, 1928 (Family Enidae) seems to be well represented on the Ethiopian Highland and in East Africa, where is possibly originated. Most species are found at rather high altitudes (up to 10,500 ft). It seems unlikely that today it occurs in the area under consideration, which is too arid.

Cerastua miocenicus was originally described from miocene deposits at Hiwegi, Kiangata and Kathwanga (Rusinga Island, Kenya) by Verdcourt (1963). Later


1



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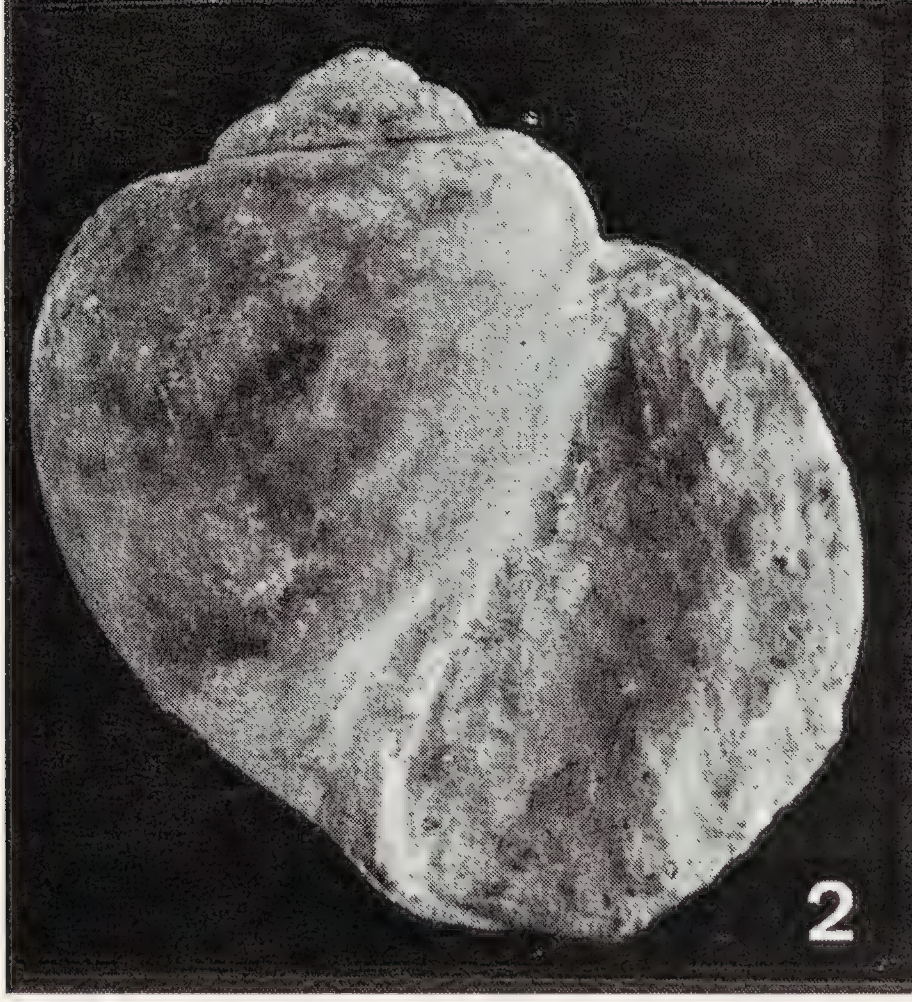
2

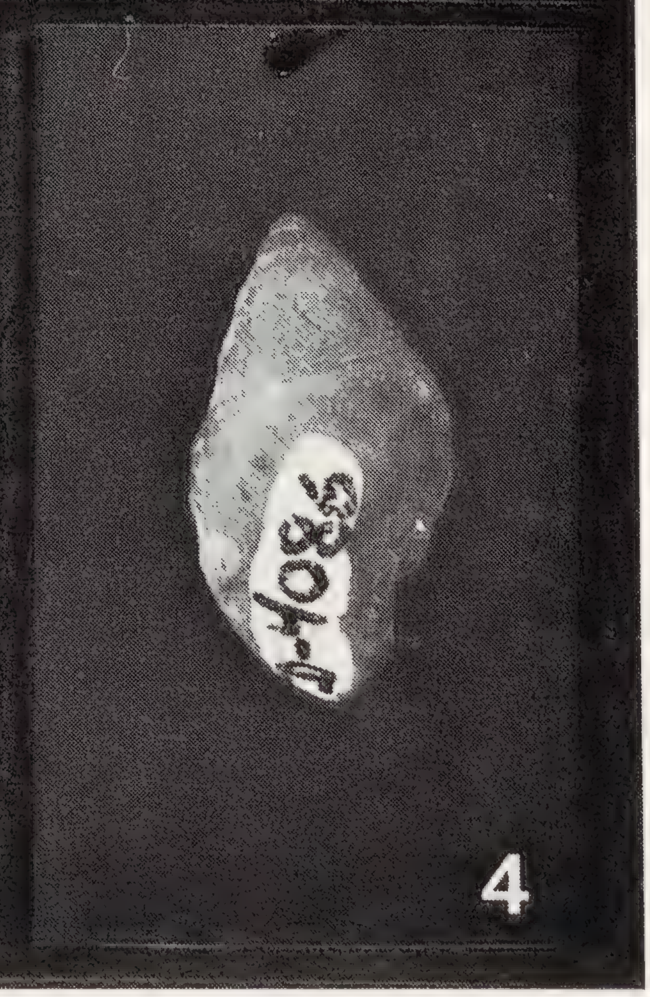

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Fig. 1. *Lanistes carinatus* (× 1½)

Fig. 2. *Pila ovata* (× 1½)

Fig. 3. *Burtoa nilotica verdcourti* (× 1½)

Fig. 4. *Cerastua miocenica* (× 2)

the same author (1967) following Strand (1928) adopted the generic name *Cerastua*, *Cerastus* being preoccupied.

Burtoa nilotica verdcourti Crowley & Pain, 1959
(Pl. XV, fig. 3)

Burtoa nilotica verdcourti T. E. Crowley & T. Pain, 1959, pp. 12–13, Pl. I, fig. 1–2.

Burtoa nilotica verdcourti B. Verdcourt, 1963, p. 14, fig. 22 & 23.

Material: Muruarot 1, 2 and 3; fifteen juvenile and one adult specimen; measurements largest specimen: H = ±42 mm.; D = 28 mm.; H aperture = ±26 mm.; D aperture = ±18 mm. Two species have retained their calcareous epiphragm, proving that they died during aestivation.

Remarks: Dr. Verdcourt compared the material with paratypes in the British Museum. It differs slightly from these types, which attain a larger size and possess probably a somewhat larger aperture.

Burtoa nilotica verdcourti is a fossil subspecies originally described from Miocene deposits at Rusinga Island (Kenya) (Crowley & Pain, 1959). The present day range of the species does not include Muruarot, where conditions are probably already too arid for the species. *Burtoa* generally occurs in evergreen forests, mountain forest and grassland, near lakes and in forest galleries.

Paleoecology

The frequence of the different species are tabulated below, together with the fossils from the same area recorded by Verdcourt (1963). This tabulation shows clearly the predominance of the ampullarids (*Pila, Lanistes* 77%).

	M1	M2	M3	total	Verdcourt (1963)
L. carinatus	16	7	6	29	+
P. ovata	4	13	4	21	+
C. miocenica	0	0	1	1	0
B. n. verdcourti	1	7	6	14	0
Limicolaria sp.	–	–	–	–	+

Ampullarids are typical inhabitants of shallow muddy lakes, papyrus swamps and periodically flooded alluvial plains or lake extensions. Hence the general environment at the time of formation of the fossil associations was predominantly of a marshy nature. Normal freshwater environment was probably very restricted as no true aquatic snails or bivalves have been found. The many landsnails on the other hand point to subaerial and drier conditions related to changes in extent of the marshy environment.

Fossil assemblages predominantly composed of ampullarids and/or landsnails are known from various localities in East Africa and associated with freshwater and volcanic deposits of Miocene and possibly early Pliocene age. Apparently these assemblages originated under comparable circumstances. Indeed East Africa may at the period under consideration have been characterised by a flat topography in an initial phase of reshaping by tectonic movements and volcanism, resulting in the development of many shallow swampy lakes. The environments of deposition have been described by Verdcourt (1963) as evergreen forest, gallery forest, bush country, savannah and swampy savannah. Fossils indicative of heavily forested biotopes are *Maizania*, *Homorus*, *Thapsia*, urocyclids and streptaxids, groups of which no representatives have yet been found at Muruarot. This negative evidence and the fact that *Cerastua miocenica* is a landsnail of bushland and woodland, and *Burtoa nilotica verdcourti* a species of forest and grass steppes, point to rather open subaerial biotopes at Muruarot.

Summarising one may say that the fossil molluscs of Muruarot certainly indicate marshy conditions, very probably relatively open subaerial environment and perhaps a greater humidity than today as suggested mainly by the presence of *B. n. verdcourti*.

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OBITUARIES

L. W. STRATTON (1900–1971)

Leonard Walter Stratton was born in Southampton on 23 October 1900 and was educated at Itchen Grammar School and later at King Alfred's College, Winchester. He took up teaching as a profession. In 1926 he married Irene May Bristow by whom he had two daughters. His early appointments were in Hampshire; firstly at Woolston Boys' School, Southampton, which was subsequently evacuated to Ringwood, in the New Forest, during the Second World War. There he served in the Home Guard as a sergeant for the duration. It was at this time that he had the opportunity of studying the local molluscan fauna and several papers from his pen were published in the *Journal of Conchology.*

In 1944 he was appointed Headmaster of Aldenham Church of England School at Delrow in Hertfordshire. There he was a sidesman at Aldenham Parish Church and later People's Warden for five years. Thence he went to Redbourn to become Headmaster of the Boys' Primary School in 1957 and there he remained till his retirement in 1965. He had, two years previously, moved to Harpenden.

This residence of twenty-six years in Hertfordshire enabled him to do extensive field work on the mollusca of the county. He was recorder for Mollusca for the Hertfordshire Natural History Society and in 1955 published, in the *Transactions* of that Society, "The Mollusca of Hertfordshire" gathering all the known records of the non-marine mollusca for the county from other workers and with the addition of his own making a comprehensive work of 38 pages. He also contributed many shorter papers and notes to the same journal.

Stratton's interest in natural history began at an early age and continued throughout his life but from 1936 it was centred in conchology and he joined the Society in 1942. He had the distinction of being elected twice to the presidential chair, 1954–56 and 1962–64. To the best of my knowledge only one other, Mr. J. R. le B. Tomlin, has been accorded this honour. During Stratton's second presidency the First European Malacological Congress was held in London, the Conchological Society of Great Britain and Ireland and the Malacological Society of London being joint hosts; he was also a member of this latter Society.

One of his most important contributions to the knowledge of our non-marine mollusca was his "The Mollusca of the Malham Area" which was the subject of his presidential address in 1956 [and which covered 25 pages in the Society's journal].

He was also the author of two successful books; "Your Book of Shell Collecting" in 1968 and "Your Book of the Seashore" in 1970. The former was the means of introducing Junior Membership in the Society to many young people. Mr. Pringle, of Messrs Faber & Faber, the publishers of these two works, remarked to me "He was an ideal author"; I know what that means, for a publisher there is nothing more helpful than to have an author who produces his manuscript on time. A third work of a more scientific nature on the ecology of mollusca was in hand when he died. It will not be passed to another to complete.

Stratton was a very competent field naturalist, delightful to work with and very thorough in his examination and search of any area he selected. He had a sound knowledge of the habits and habitats of British mollusca and the present writer remembers a very profitable week spent with him at Dale Fort Field Centre in 1963 when we covered marine collecting as well as the non-marine species. He was Chairman of the Marine Census Committee of the Society. He worked with Dr. H. E. Quick on several field courses both at Juniper Hall, Surrey, and Malham in Yorkshire.

He did not describe any new species of mollusc but one species is named after him of which he writes "... my only claim to fame is in *Placostylus strattoni* Pain. Always regarded as something of a joke as it was bought, with others, for 2s. 6d. in a junk shop." This humility was typical of him.

He died on 22 January 1971 at his home in Harpenden after a short illness which followed a successful major operation some months previously from which we thought he had made a very good recovery and gained a much longer lease of useful life.

Stratton's mollusca collection was purchased jointly by the Manchester Museum and Leeds City Museum. The catalogued collection, consisting of some 7,500 sets was divided as follows. To Leeds, British marine mollusca, British and foreign *Unionacea* (excluding Australian *Mutelidae*), foreign marine bivalves. To Manchester went the British non-marine mollusca (excluding the *Unionacea*), foreign non-marine mollusca (excluding *Unionacea*), Australian marine mollusca, New Zealand land mollusca, the Australian *Mutelidae* and fossil mollusca. The duplicate, uncatalogued material in each group was taken by the other museum.

H. E. J. Biggs

LIST OF PUBLICATIONS BY L. W. STRATTON

1945 Snails of the Avon Valley, Hampshire. *J. Conch.* **22**: 134–135.
1945 *Planorbis corneus* in Herts. *J. Conch.* **22**: 172.
1946 Some New Forest Snails. *J. Conch.* **22**: 197–199.
1946 *Arion ater* var *albolateralis* Roebuck. *J. Conch.* **22**: 177.
1946 *Arion ater var albolateralis* Roebuck. *Trans. Herts. Nat. Hist. Soc.* **22**: 163.
1946 Erosion of *Lymnaea stagnalis*. *J. Conch.* **22**: 208–214.
1947 Mollusca of Wicken Fen. *J. Conch.* **22**: 247.
1948 *Succinea elegans* Rossm. in Herts. *J. Conch.* **22**: 304.
1948 Flood debris from the River Colne. *Trans. Herts. Nat. Hist. Soc.* **23**: 24–29.
1948 Useful Sparrows. *Trans. Herts. Nat. Hist. Soc.* **23**: 37.
1948 Behaviour of a Robin with a Millepede. *Trans. Herts. Nat. Hist. Soc.* **23**: 37.
1949 Colonization of Land Snails. *J. Conch.* **23**: 43.
1949 *Succinea* in Hertfordshire. *Trans. Herts. Nat. Hist. Soc.* **23**: 72–73.

PLATE XVI

with best wishes,

Leonard W. Stratton.

Plate XVII

F. A. Schilder

1950 Habitat of *Clausilia rolphii* Turton. *J. Conch.* **23**: 101–104.
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1960 Some Variations in the Unionidae. *J. Conch.* **24**: 433–437.
1962 (Review) *Sea Shells of the World. J. Conch.* **25**: 136.
1962 The Cardiacea. *The Conchologists' Newsletter.* No. 4: 19–20.
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1963 An Ecological Study. *J. Conch.* **25**: 174–179.
1963 (Review) *Marine Mollusca of Victoria. J. Conch.* **25**: 206.
1963 (Review) Contributions to the Knowledge of South African marine Mollusca. Part III Gastropoda: Prosobranchiata: Taenioglossa. *J. Conch.* **25**: 207.
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1969 What Price Shells? *The Conchologists' Newsletter* No. 30: 108.
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1970 *Your Book of the Seashore.* Faber & Faber.
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FRANZ ALFRED SCHILDER

(13 April 1896–11 August 1970)

As Professor Schilder outlived his contemporaries it falls to a former student of his to write an appreciation of her venerated teacher. He was always kind and serene, had a keen sense of humour, was a brilliant lecturer, and was like a father to his students.

He was born an Austrian, the son of Dr. Franz Schilder, an officer at Prague who in 1908 took up a government post in Vienna. The young Franz Alfred showed an early interest in zoology and when only 14 published some papers on beetles (Cicindelidae). Leaving school in 1914 he began to study medicine in Vienna but his studies were interrupted, a year later, by war service, and after the war he did not return to medicine but began new studies in ethnography, geography and palaeontology. It was an ethnological book *Muschelgeldstudien* by O. Schneider that first made him turn his attention to the study of the Cypraeacea, in which he became so interested that he took it for his dissertation to obtain the degree of Dr. phil. The account was written in 1921 but appeared only in abstract (Wien, 1923). For the rest of his life the Cypraeidae remained his chief interest, though he also did much work in entomology and other disciplines.

Newly qualified, Dr. Schilder moved to Berlin, but due to inflation times were difficult for young scientists and in the first few years he held several different positions. During this period he met and married Dr. Maria Hertrich from Munich and found in her an enthusiastic and reliable collaborator in his work. Their only child Franziska died in 1961.

In 1925 Dr. Schilder became an established scientist at Naumburg/Saale, in the state institute for research on *Phylloxera*, where he remained until 1947. But all their spare time the Schilders spent working with Cypraeidae, sometimes also with *Cepaea* and their holidays were used in studying material in public and private collections of many countries.

The last war put an end to their travelling and cut off many connections, and for some years research in *Cepaea* was their main work. After the war Dr. Schilder was appointed Professor of Zoology at the Martin-Luther University at Halle. At first he gave lectures only on zoogeography and biometry and continued his main work at Naumburg, but in 1947 he moved to Halle and lectured also on genetics and anthropology. It was a great change for a man in his fifties but it was highly successful. His lectures were most interesting and his students enjoyed them. Later he was asked to lecture also at the University of Leipzig, and from 1954 until 1963 he spent one day a week in Leipzig. I remember that then biometry lectures were given by him in the evening, at the end of a tiring day. We went to his lectures tired, but after a few minutes he had caught our attention and held it for two hours!

Professor Schilder retired in 1962, but even then he was still asked to lecture very frequently. Unfortunately he suffered from asthma in his later years and ceased lecturing altogether by 1966. As an emeritus, master of his own time, he still worked, but only on his beloved Cypraea. As he felt his strength failing he prepared each piece of research for publication, knowing that the great monograph of Cypraeacea that he had hoped to write would not be accomplished. A summary and conclusion of his work is "A Catalogue of living and fossil Cowries (Nomenclature and Bibliography of Cypraeacea and Triviacea)" written jointly with Maria Schilder, to be published in Brussels.

His countrymen were not much interested in Schilder's Cypraea studies, and most of them even regretted that he spent his great gifts on such work. But he went his own way and cared not for their opinion.

He has left us a gigantic amount of work, his complete bibliography comprising more than 400 titles, malacological, entomological, biometrical, etc. as well as books for his students. He also, together with his wife, established 45 new genera and 483 new species and subspecies. The following have been named in his honour; the genus *Schilderia* Tomlin 1930; the recent species *Lyncina schilderorum* Iredale 1939, the fossil species *Zoila schilderi* Dey (1932) 1941, and the race *Cypraea tigris schilderiana* Cate 1961.

Professor Schilder was a member of both English societies, of the German Zoological Society, the German Malacozoological Society, and an honorary member of the Hawaiian Malacological Society and the Keppel Bay Shell Club.

Unfortunately his work on Cypraea will probably not be continued in the German Democratic Republic. Dr. Maria Schilder does not feel able to continue her late husband's work by herself, and they have had neither a son nor a personal scholar to succeed them in their special discipline.

HILDEGARD ZEISSLER

For almost half a century Franz Albert Schilder was one of the foremost authorities on Cypraeacea, and in particular on Cypraeidae. He published hundreds of papers on many aspects of the group, concentrating principally on nomenclature, conchology, the anatomy of preserved specimens, on fossils, and on statistical studies. He combined great industry with a magnificent eye for detail.

One of the greatest disadvantages under which Schilder laboured was that, mainly due to the location of his home, he was unable to undertake work in the field. Indeed, it is said that he only twice saw living cowries, *C. lurida* in Sicilian waters and *C. tigris* in a Berlin aquarium. This was a serious limitation to him, and in the opinion of some authorities led him to undervalue the effects of local environmental conditions on shell variation. In consequence his system of subspecies, first propounded in *Proc. Malac. Soc. Lond.* 23 (1938), and amplified in many subsequent papers, now finds increasingly less acceptance. Perhaps, too, the term "race" as used by Schilder does not quite have the modern meaning of the word "subspecies", but harks back to the formerly used "variety".

Nor have the genera proposed by Schilder been accepted without criticism. It has been claimed that the points of difference between them are not sufficiently clear, and that it will be necessary to study the living animals in far greater detail before it will be possible to find any basis for generic subdivision of Cypraeidae.

Despite these criticisms, Schilder's system must and will remain the starting point for all future work. His perception and industry cleared away much confusion in nomenclature, and established a list of valid species which, with amendments due to later research, remains one of the most useful forward steps ever taken in the study of Cypraeidae.

John Griffiths

A complete list of Dr. Schilder's papers will appear in *Archiv für Molluskenkunde* no. 1/2 in 1971. Editor.

WILLIAM ERNEST ALKINS (1896–1969)

Dr. William Ernest Alkins died at Bank Street, Cheadle, Staffordshire, on 18 December 1969, aged 73. His home was at Claremont, Park Lane, Cheadle. His early schooling was at Kingsley Parish School, and in 1908 he entered the Leek High School on an endowment scholarship. Later on he went to Manchester University where in 1918 he graduated with honours in chemistry and gained his B.Sc. and other awards. For the next three years he lectured in the Department of Metallurgy at Manchester University and received the degree of M.Sc. in 1919. In 1921 he joined the firm of Thomas Bolton and Son Ltd. as Head of Research and in 1934 he received at Manchester University the degree of D.Sc. for his researches in metallurgy and other sciences.

At Messrs Bolton's Dr. Alkins became responsible for production in Staffordshire from 1940–1954 and reached the position of chief metallurgist. In 1962 he retired from the post of executive having been elected to the Board in 1951. He afterwards remained at Messrs Bolton's as a non-executive director and consultant, and became associated with the British Insulated Callender's Cables Research Organisation, and with the Institution of Metallurgists of which he was a Founder Fellow.

He married Miss Edith Bottomly, a graduate of Manchester University; she predeceased him in 1967.

As well as in geology and fly-fishing Dr. Alkins had a great interest in conchology, especially the land and freshwater Mollsuca. He was elected a member of the Conchological Society on 13 February 1918 and often attended meetings, bringing many exhibits of shells from Manchester and his home area.

On his return to North Staffordshire in 1921 he became a strong supporter of the North Staffordshire Branch of the Society, reading papers and exhibiting local finds. One of his early papers read at a meeting of the Branch was "Some Recent Records of Mollusca in the Churnet Valley and North Staffordshire" (published in *Trans. North Staffordshire Field Club* Jan. 1922).

In 1928 Dr. Alkins read an important paper on "The Distribution of Pisidia in the Oakamoor district" (also published in *Trans. North Staffordshire Field Club*), and in 1928 his paper on "The Conchometric Relationship of *Clausilia rugosa* (Drap.) and *Clausilia cravenensis* Taylor" appeared in the *Proc. Malac. Soc.* vol. 18. This latter research was carried out by means of a grant from the Royal Society.

In the early years of his conchological career Dr. Alkins read papers and notes at meetings of the Conchological Society in Manchester and many were published in the *Journal.* They included papers of statistical interest such as some of the following: "Notes on the growth and variation of *Unio pictorum* (Linne)", based on 250 examples (*J. Conch.* **16**: 228–233. 1921); "Two molluscan associations in North-East Staffordshire" (*J. Conch.* **16**: 291–296. 1922); "Note on the variations of *Clausilia itala* Martens", an analysis of some 180 examples from the Lake Como area collected by E. Collier (*J. Conch.* **17**: 81–83. 1923); "Note on the variation of *Ena obscura* (Müller)", a study of 500 specimens from Oakamoor, Staffordshire (*J. Conch.* **17**: 35–39. 1923); "Note on a colony of *Vitrea lucida* (Drap.) at Arnside, Westmorland" (*J. Conch.* **17**: 157–8. 1924); "Note on the habits of *Hygromia fusca* (Montagu)" (*J. Conch.* **17**: 243–7. 1925); "Notes on the Land Mollusca of the Llandudno District" (*J. Conch.* **18**: 266–7. 1928).

Items of Dr. Alkins' business career have been extracted from *The Leek Post and Times* of 23 December 1969.

J. W. Jackson

During the last few years Dr. Alkins contributed many records to the Census of the British non-marine Mollusca. Editor.

DENNIS HARPER KENNELLY (1890–1971)

In D. H. Kennelly, the world of conchology has lost a gentle and generous enthusiast. Born in Grahamstown, South Africa, on 6 May 1890, he worked in a bank after leaving school and from 1936 to 1938, took an appointment as conchologist at the Port Elizabeth Museum, before moving to Uitenhage. He became a Friend of the East London Museum on its inception in 1931, and in 1961 he offered his entire collection as a gift to that Institution. In acepting this offer, the Museum Director suggested that he be appointed Honorary Conchologist, and he assumed this post on 1 January 1962.

He joined the Conchological Society of Southern Africa in 1958, soon after its formation, and took a very lively interest in its activities; himself an ardent collector and student, he was always ready to share his knowledge both in conversation and by writing articles. He was voted an honorary member of that Society in 1961, elected President in 1964, and remained in that office until his death on 1 March of this year.

His main interest was in marine gastropods, and he wrote the well-known book "Marine Shells of Southern Africa", first published 1964, a second, revised and enlarged issue appearing in 1969. He also compiled three definitive shell lists for areas on the South African coasts.

Kennelly joined our own Society in 1959, and although there is no record of his ever having visited this country, he made a number of friends here through correspondence. He was one of those people who are able to put a great deal of themselves into their letters, and to receive one from him was like having an old friend come through the door. His unreserved enthusiasm and happy personality made him a universally popular President in South African circles, but the loss resulting from his sudden death must be shared by conchology as a whole.

T. E. CROWLEY

Literary Contributions to Conchology — D. H. Kennelly

"The Marine Shells of Southern Africa", 1964 (Thos. Nelson & Sons).
ditto Second enlarged edition. 1969. (Books of Africa Ltd.).
A Preliminary List of South African Marine Shells from False Bay to the Pondoland/Natal Border. 1963. (Published in roneo form by the East London Museum.)
A List of Marine Mollusca taken alive on the 'Wild Coast', South Africa. 1965. (Published in roneo form by the East London Museum.)
Marine Mollusca taken alive on the 'Wild Coast', South Africa, Supplementary List No. 1. 1967. (Published in roneo form by the East London Museum.)
Annals Cape Provincial Museums, Vol. III, pages 82/84, Aug. 1963. Notes on two species of *Cymatium* in South Africa.
Annals Cape Provincial Museums, Vol. V., pages 163/165, Aug. 1966. Notes on *Charonia pustulata*, Euthyme, South Africa's largest Gastropod.
"The Cowry". (Editor Lt. Col. R. J. Griffiths.)
Vol. 1, No. 3, page 41. 1/2/1962. Range of three South African Cypraeidae.
No. 4, page 59. 15/8/62. *Cypraea fuscorubra*, Shaw.
No. 5, page 74. 1/3/1963. The range of *Cypraea citrina*, Gray.
No. 6, page 91. 18/1/1964. *Cypraea marginalis*, Dillwyn.
page 93. *Cypraea helvola meridionalis* S & S.
Cy praea felina, Gmelin, in South Africa.
No. 7, page 108. 1/11/1964. *Cypraea chinensis*, Gmelin.
Vol. 2, No. 1, page 6. (No date.) The range of *Cypraea caputserpentis*, Linne., in South Africa.
Contributions to Circulars 3 to 127, Conchological Society of Southern Africa.

OFFICERS AND COUNCIL FOR 1971-1972

President:

T. Pain

Vice-Presidents:

J. W. Jackson, D.Sc., F.S.A., F.G.S.
A. E. Ellis, M.A., F.L.S., F.Z.S.
Mrs. N. F. McMillan, M.R.I.A.
Rev. H. E. J. Biggs, F.L.S.
C. P. Castell, B.Sc.
M. P. Kerney, Ph.D.
S. P. Dance
B. Verdcourt, Ph.D.

Hon. Secretary:
Miss J. T. Sawyer, B.A.

Hon. Treasurer:
Mrs. M. Fogan, B.Sc.

Hon. Editor:

Mrs. N. F. McMillan, M.R.I.A.

Hon. Recorders:

Non-Marine Mollusca: M. P. Kerney, Ph.D.
Marine Mollusca: Mrs. S. M. Turk, F.Z.S.

Council:

P. E. Negus
T. E. Crowley, B.Sc.
J. Llewellyn Jones, B.Sc.
A. Norris
A. P. H. Oliver
Mrs. E. B. Rands

THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1970

	£	£	£
Publications:			
News Letter			383·58
Student Papers			94·30
Journal:			
Volume 27 No. 2	512·65		
Authors Reprints	39·20	473·45	
Volume 27 No. 3	550·65		
Authors Reprints	20·43		
		530·22	1,003·67
Field Meetings			10·88
Sundry Expenses			1·96
Bank Charges			5·67
Printing, Stationery and Postage			165·17
Officers Expenses			63·30
Subscriptions			8·00
			1,736·53
Net Surplus			137·72
			£1,874·25

	£	£
Fees and Subscriptions:		
Membership Fees	997·08	
Subscribers	308·62	
Entrance Fees	28·12	
		1,333·82
Donations:		2·78
Sales:		
Advertising	5·91	
Journals	98·28	
Student Papers	61·01	
News Letter	17·00	
Sale of Back Numbers	50·50	
Sundry Receipts	·61	233·31
Investment Income:		
General Account	258·70	
Life Members Fund	45·64	
Reserve and Research Fund	70·70	
	375·04	
Transfer to Reserve and Research Fund	70·70	304·34
		£1,874·25

BALANCE SHEET AS AT 31st DECEMBER, 1970

		£
Fees and Subscriptions in Advance ...		109·46
Life Membership Fund		710·00
Reserve and Research Fund		1,170·70
Capital Account		
Balance Bt./Fwd.	4,204·00	
Add Surplus	137·72	
		4,341·72
		£6,331·88

	£	£
Cash at Bank: Current Account ...	400·58	
Deposit Account ...	1,558·38	
Cash in Hand	3·04	
		1,962·00
Investments:		
£400 5% Treasury Stock 1986/89 (£245·00)	344·00	
£500 5¾% Deb. Stock Mersey Docks and Harbour Board 1976/78 (£250·00)	460·85	
£737 13s. 5d. 6¾% Stock Greater London Council (£671·27) ...	721·52	
2,514 Units M. & G. Dividend Fund (£1,382·70)	1,522·06	
£400 5⅝% Loan City of Norwich	400·00	
£800 5½% Loan London County Council	769·20	
420 Scotbor Income Units (£119·00)	152·25	
		4,369·88
		£6,331·88

Charles Pettitt }
Wm. F. Edwards } Hon. Auditors.

2 February 1971

Marjorie Fogan,
Hon. Treasurer.

J. Conch. 27: 438–450 (1972)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

862nd (ORDINARY) MEETING, 21 MARCH 1970

Communications. "A proposed new genus of cerithid Mollusca from the Dahlak Islands by Rev. H. E. J. Biggs. "Some aspects of the behaviour of pest species of slugs" by D. M. Duval. "The identity of *Conus mappa* (Lightfoot), *C. insularis* Gmelin, *C. aurantius* Hwass, in Bruguière, and Hwass's infraspecific taxa of *C. cedonulli*" by John Holeman and Professor A. J. Kohn of the University of Washington, Seattle.
Lecture. "The living world of sea shells", illustrated with colour slides, by J. Llewellyn Jones.

Members Elected

J. F. S. Phillips, C.M.G., i.d.c., M.A., H.M. Ambassador, Aden, c/o Outward Bag Room, F.C.O., King Charles Street, London S.W.1.
J. W. Rivers, 9 Goosecroft, Hemel Hempstead, Herts.
A. W. Sackett, 33 Lodge Close, Fetcham, Leatherhead, Surrey.
D. Stirk, 48 Leadwell Lane, Rothwell, Leeds LS26 0SS.
R. A. S. Storey, B.Sc., Biology Dept., Wolfreton School, Carr Lane, Willerby, Hull.
Dr. J. O. Young, Dept. of Zoology, University of Liverpool, Brownlow Street, P.O. Box 147, Liverpool L69 38X.

863rd (ORDINARY) MEETING, 18 APRIL 1970

(Held at Manchester Museum)

Lecture. Dr. J. W. Jackson, the Society's senior Member and a previous President, Librarian and Secretary, related some interesting details of the Society's history and some personal reminiscences about his work in the field of conchology and about the people he had met in the course of it. The President, on behalf of the Society, then presented Dr. Jackson with a letter of appreciation for his long service to the Society and to the study of Mollusca on the approach of Dr. Jackson's 90th birthday.

Members Elected

Dr. C. R. Bantock, 78 Claremont Road, Highgate, London N.6.
Gloria Maris Conchyliogische Vereniging, c/o Mr. J. Wuyts, Secretary, Wetstraat 58, 2000 Antwerpen, Belgium.
E. Kellock, Duntuilm, Knock, Huntly, Aberdeenshire AB5 5LJ.
D. F. C. Yew, P.O. Box 3215, Singapore.

864th (ORDINARY) MEETING, 16 MAY 1970

Communications. "*Fagotia acicularis* (Férussac) from the Quaternary deposits in the valleys of Helme and Unstrut" by Dr. H. Zeissler. "William Pennington Cocks" by Mrs. S. M. Turk. "Mollusca of the Iranian Plateau, No. 3" by Rev. H. E. J. Biggs.
Lecture. "Snail Anatomy" by M. R. Block, illustrated by paper cut-outs forming a "Do it yourself snail".

MEMBERS ELECTED

M. J. Bishop, M.A., Ph.D., Sidney Sussex College, Cambridge CB2 3HU.
Mrs. M. P. Hill-Cottingham, B.Sc., M.I.Biol., 36 Station Road, Blackwell, Bristol.
T. J. Klonowski, 25 Bridgeman Street, Buffalo, New York 14207, U.S.A.
R. W. Morrell, F.G.S., 23 Pinders House Road, Nottingham NG2 3EG.
P. Peskey, Bansara, Collings Road, St. Peter Port, Guernsey, C.I.
P. Piani, via delle Fragole 23, 40137 Bologna, Italy.

865TH (ORDINARY) MEETING, 17 OCTOBER 1970

Communications. "A reappraisal of the geographical distribution of the Cockles, *Cardium edule* L. and *C. glaucum* Brugière" by Dr. P. J. Russell. "*Rissoa violacea* Desmarest, *R. lilacina* Récluz, *R. rufilabrum* Alder, and *R. porifera* Lovén, and their distribution in British and Irish waters" by Dr. Shelagh Smith. "Some ecological data on molluscs collected in Ireland in 1969" by George Visser.
Lecture. "Shell collecting in the China Sea" by A. P. H. Oliver.

MEMBERS DECEASED

Dr. W. E. Alkins, Claremont, Park Lane, Cheadle, Stoke-on-Trent, Staffs.
Professor Dr. F. A. Schilder, 19 Schleiermacher Strasse, Halle/Saale, G.D.R.

SPECIAL GENERAL MEETING, 21 NOVEMBER 1970

RESOLVED THAT with effect from 1 January 1971

1. The annual subscription for Ordinary Members shall be £3.
2. The rate for Subscribers to the Journal (mostly libraries and institutions) shall be £4 per annum.
3. There shall be a "Family Subscription" rate of £4 per annum for husband and wife together who would enjoy all the advantages of Membership but would share one set of the Society's publications.

866TH (ORDINARY) MEETING, 21 NOVEMBER 1970

Communication. "Vertical range of Molluscs on Ben Lawers, Scotland" by S. P. Dance.
Lecture. Three films were shown including "Between the Tides" showing British marine shore-life filmed in South Wales, introduced by J. Llewellyn Jones; and "The Threat in the Water", concerning Bilharzia and made by the Shell Organisation, introduced by A. P. H. Oliver.

MEMBERS ELECTED

(Arnhem) Rijksinstituut voor Natuurbeheer, Kemperbergerweg 11, Arnhem, Holland.
P. R. Cobb, 10 Broadway, Heacham, King's Lynn, Norfolk.
Miss C. Davidson, The Little House, 49 High Street, Wavertree, Liverpool 15.
B. L. Day, 50 Howard Road, Cambridge.
M. McK. Deas, 41 Martin Lane, Bawtry, Doncaster, Yorks.
Mrs. J. Groom, Briarmead, Ockham Road North, East Horsley, Surrey.
K. J. Hyde, Wappenshall Farm, Wellington, Salop.
Sgt. W. J. Jones, Sergeant's Mess, R.A.F. Henlow, Bedfordshire.
Capt. T. A. Lowe, Silver Birches, Candlesby, Spilsby, Lincolnshire.

F. J. G. Luther, Manager, Cable & Wireless Ltd., Box 14, Muscat, Oman, Arabian Gulf.
R. W. Miller, B.S., 1105 Queen Anne Road, Teaneck, N.J. 07666, U.S.A.
C. Moore, 5 Maes-y-Felin, Lampeter, Cardiganshire, Wales.
Mrs. D. Neville, 7 Camden Terrace, London N.W.1.
B. Parkinson, New Guinea Shells, P.O. Box 259, Lae, New Guinea.
Fil. mag. T. Porsne, Smedjegatan 2, S-621 00 Visby, Sweden.
G. W. H. Reed, B.Sc., C.Eng., A.M.I.M.M., Hawthorn Cottage, Hollow Road, Shipham, Somerset.
M. S. Smith, 12 Barker Road, Chertsey, Surrey.
S/Sgt. P. Smith, R.A.P.C., 6 Gables Close, Nursteed Road, Devizes, Wilts.
D. L. Topley, 36 The Grove, West Wickham, Kent.
S/Sgt. E. W. Unwin, CSO's Branch, HQ Scotland (Army), P.O. Box 85, G.P.O. Edinburgh EH1 2YX, Scotland.
P. L. Whitehead, Solva, 21 Sunningdale Avenue, Ayr, Scotland.
Dr. C. S. Woods, Zoology Department, University College, Galway, Ireland.
R. Wrigley, 13 Lowther Avenue, Culcheth, Warrington, Lancs.

867TH (ORDINARY) MEETING, 19 DECEMBER 1970

Lecture. "Helix on Helicon" concerning poetry about snails, by A. E. Ellis, M.A.

MEMBERS ELECTED

C. J. Burnell, 1 Aldenham Road, Newton, Porthcawl, Glamorganshire.
T. S. H. Gibson, 14 Carmalt Gardens, London S.W.15.
Lady MacDermot, Portacarron, Oughterard, Co. Galway, Eire.
R. G. Meiklejohn, 52 Heathfield Road, Thurso, Caithness.
Dr. D. Singmaster, 51 Fitzjohn's Avenue, London N.W.3.
Rev. P. J. Smith, SDB, Thornleigh College, Sharples Park, Bolton BL1 6PQ.
A. Walton, A.I.O.B., Grey Lyn, St. Ann's Orchard, Faversham, Kent.

868TH (ORDINARY) MEETING, 16 JANUARY 1971

Communications. "*Potamopyrgus jenkinsi* (Smith) in a deposit at Sealand, near Chester" by Mrs. N. F. McMillan. "The British distribution of *Pomatias elegans* (Müller)" by Dr. M. P. Kerney.
Lecture. "Collecting non-marine Mollusca in the Pacific Islands" by J. Peake, illustrated by colour slides of the Marquesas and Solomon Is.

MEMBERS ELECTED

P. J. Harding, 44 Carisbrooke Way, Cyn Coed, Cardiff.
M. Lambiotte, (Vice-President, Belgian Association for Malacology, Conchology and Palaeontology), Avenue des Lilas 54, B-1410 Waterloo, Belgium.
Dr. P. Panetta, via Acclavio 64, 74100 Taranto, Italy.
D. G. Rands, 51 Wychwood Avenue, Luton LU2 7HT, Bedfordshire.
T. C. Rice, P.O. Box 33, Port Gamble, Washington, 98364, U.S.A.

SPECIAL GENERAL MEETING, 27 FEBRUARY 1971

RESOLVED that with immediate effect those seeking Life Membership shall pay a compound fee of £60.

869TH (ANNUAL GENERAL) MEETING, 27 FEBRUARY 1971

In the Chair the President, Mr. T. Pain, and 54 Members and friends present.
Lecture. Presidential Address. "The *Ampullariidae,* an historical survey" by T. Pain.
Election of Auditors. W. F. Edwards and C. W. Pettitt were re-elected.
Election of Officers for 1971/72. Due to the British postal strike it had not been possible for completed ballot papers to be returned to the Secretary. It was therefore agreed that the present Officers should remain in office until the counting of votes had taken place.

MEMBERS ELECTED

R. L. Tucker, M.B.E., Rest Cottage, Stokenham, Kingsbridge, S. Devon.
L. R. West, 29 Wyndham Avenue, Exeter, Devon.
H. J. Wilson, 23 St. Monica Grove, Crossgate Moor, Durham.
A. F. Woodhead, c/o Sudan Gezira Board, P.O. Box 185, Port Sudan, Republic of Sudan.

MEMBER DECEASED

L. W. Stratton, 65 Park Rise, Harpenden, Herts.

With all present standing the President announced the sad loss of this prominent Member of the Society, following which a minute's silence was observed. Rev. Biggs then paid tribute to Mr. Stratton as a conchologist and as a past President and an active Member of the Society. He announced Council's decision that the Society could best show its appreciation by means of a contribution to the Sir Malcolm Sargent Cancer Fund for Children, a cause in which Mr. Stratton was deeply interested. It would be open to all Members to contribute to this appeal.
Vote of Thanks. To the British Museum Trustees for permission to use the Museum's facilities. This was proposed from the Chair and passed unanimously.

J. T. SAWYER

ANNUAL REPORT OF THE COUNCIL, 27 FEBRUARY 1971

The Society now has 493 Members, of whom some two-fifths live outside the United Kingdom. Forty-seven new Members have been added during 1970–71, rather less than last year, but this may be accounted for by new rules which require the aspiring Member to pay his first subscription before he is fully admitted to the ranks. There have been 12 deletions for non-payment of subscription and 11 resignations—in fact fewer resignations than last year, despite recent increases in subscription rates which might have been expected to deter membership renewal.

Three Members have unfortunately died recently, including Professor Dr. F. A. Schilder of East Germany and Mr. L. W. Stratton.

One Annual General Meeting, two Special General Meetings and seven Ordinary Meetings have been held this year at which the average attendance was just over 45. The highest attendance registered was 59 in November, as compared with 64 in October 1969, and these figures, coupled with a net gain of only 28 new Members as compared with 33 in the previous year, would seem to indicate a slight falling off in the Society's growth rate.

A new development in the Society's activities has been the introduction of an out-of-London meeting during each season. One was held at Manchester Museum in April 1970 and this April a similar meeting is planned, based on Leeds.

Two *Journals* were published last year. The *Newsletter* appeared with quarterly regularity and one *Paper for Students* was also published.

The Council has also discussed topics of more general scientific interest such as pollution and conservation issues. Here the Society is to offer the assistance of its Member experts to local nature trusts and natural history societies for such purposes as the classification and preservation of habitats. This work is to be co-ordinated by Mr. P. E. Negus.

During the coming year the chief problems which the Society will have to face seem most likely to be of a financial nature. In particular must be mentioned the Government's proposal to charge entrance fees to museums, and the British Museum's proposal to make hire charges for the use of their facilities, i.e. for the Conversazione Room and the Lecture Theatre when required. These are both matters which the Council will study on the Society's behalf.

Miss J. T. Sawyer
Hon. Secretary

TREASURER'S REPORT, 1970

The main item which must be considered in this Report is the fact that it has unfortunately been found necessary to increase the Society's subscription rates in 1971.

This fact must not be taken to imply that the Society is in desperate straits. In anything like reasonably stable circumstances its condition would be decidedly prosperous, since income from all sources continues to rise. It must be unhappily apparent to all Members that these are times of very great inflation. During the past two years a progressive rise in all our costs has caused concern, but it had seemed possible that the increased income, combined with strict attention to economy, would have been sufficient to contain this. At this point I should like to express my appreciaion to the Officers of the Society for their co-operation in putting into effect every possible economy, and also to those responsible for the Society's printing and duplicating, who have shown the greatest consideration and taken a large amount of trouble in assisting in keeping costs to a minimum. In the event it has been possible to end 1970 with an excess of income over expenditure. Although this is gratifying it should be remembered that the sale of the stock of Vol. 25 of the *Journal* and the *Supplement* was responsible for the addition of over £50 to income, which of course cannot be regarded as a normal annual contribution : furthermore, it has not yet been possible to make up publication delays of the *Journal*—although it is expected that this will be achieved during 1971—and therefore the income is still swollen by the interest on the *Journal* allocations still held in the deposit account.

The Society was warned in advance by the printers of the *Journal* of large increases in costs, due to a wages award, and it is also known that we may expect heavy increases in postal charges in 1971. After very careful consideration of all the figures I was compelled to inform the Council that it would appear to be impossible to balance our annual income and expenditure without either a drastic cut in publications or an increase in subscription rates. A Special General Meeting was called in November, and agreed unanimously upon the sugested increases. An additional type of Membership, known as "Family Membership" was also instituted for the benefit of husband and wife who may both wish to be Members : the Annual Subscription for the two is £4, but they receive only one set of publications. Since the wording of the circular describing the new rates has proved to be slightly ambiguous I should like to make it quite clear that all Members receive all publications, and the Member's Annual Subscription is now £3, with Junior Member's Annual Subscription 50p. "*Journal* Subscribers" refers to those libraries etc. which subscribe for publications without being Members, and the rate for these is now £4 per year.

The Covenant Scheme has continued to expand and in 1970 it was possible to claim the very useful addition to income of over £70. The Society is grateful to all Members who have taken the opportunity of paying their Annual Subscriptions in this way, and hopes that any others who may be eligible will give it their consideration.

I regret to have to say that more than twenty Members are still in arrears with 1970 Subscriptions; publications will not be sent to these Members pending receipt of overdue subscriptions. All Members are requested to forward subscriptions as soon as possible, to avoid the necessity of sending out reminders. In view of the increase in postal rates only two reminders will be sent this year to Members in arrears, instead of three as in the past.

Some anxiety is felt in connection with one of the Society's investments, namely the Mersey Docks and Harbour Board. As the position here has not yet been clarified it is unfortunately impossible to forecast the final outcome.

This year's Balance Sheet has been decimalised, and in future all payments to the Society will, of course, be payable in this form.

It will be seen that the present time is a difficult one, and it is impossible to look towards the future with any feeling of complacency. I do nevertheless hope that the measures which have been taken will maintain the Society's finances in a healthy condition, and feel sure that I can look forward to the co-operation of Officers and Members which they have so well afforded in the past.

Marjorie Fogan
Hon. Treasurer

FIELD MEETINGS

Eleven field meetings were held during 1970, as follows: 1 March, Sheppey, Kent; 15 March, Rye and Camber, Sussex; 19 April, Southport, Lancs.; 9 May, Porton Down, Wilts.; 6 June, Leicester area; 19–21 June, Swanage, Dorset; 11 July, Bramber and Lancing, Sussex; 8 August, Norfolk coast; 22 August, Devizes, Wilts.; 13 September, Olney, Bucks.; 18 October, Newbury, Berks.

Thanks are due to the following for leading these meetings: Miss J. T. Sawyer, Messrs. M. R. Block, P. G. Cambridge, G. Dinesen, I. M. Evans, J. Llewellyn-Jones, A. P. H. Oliver, G. Osborn, C. W. Pettitt, D. G. Pickrell,, A. J. Rundle and Dr. M. P. Kerney.

Details of many of these meetings are published in the *Conchologists' Newsletter*. Field meetings are also held by the Society's Yorkshire Branch and by the North-West Conchological Group; reports of field meetings held by the latter group appear in the *Conchologists' Newsletter*.

T. Pain

REPORT ON JUNIOR MEMBERSHIP, 1970–1971

Membership. Twenty-seven new junior members have been elected; this is more than double the number for the best year previously. Two have been transferred to full membership in the Society, we have lost two members by resignation and two more for non-payment of dues.

Papers for Students. Only one new title has been published this year, namely, No. 13 "Collecting Tropical Marine Molluscs" by A. P. H. Oliver and Mary Saul. This appeared on 30 December 1970 and consisted of 7 pages—the new price is 12p. There have been several reprints necessitated by the vigour of our sales. No. 2 was reprinted on 5 May and No. 4 on 8 June. They were of the original set of 4 published in June 1964. No. 5 "The Preparation of the Radula" by Mr. D. Claugher has been entirely revised and enlarged to meet the demand for it. It now consists of 9 pages (3 of figures) and the revised price 20p.

Publicity. Only one new item of publicity has come to my notice as a junior applying for membership mentioned it. Dr. J. C. Smith in his work "Shells and Shellfish" published in 1968 mentioned the Society and its junior membership.

Sales. There being no post coming in during the last month of the year under review our sales have been reduced. This year sales have amounted to £44 12s. 11d. which is about 25 per cent. less than last year.

H. E. J. Biggs

RECORDER'S REPORT : NON-MARINE MOLLUSCA

A. 10-Kilometre Square Mapping

This has been another reasonably satisfactory year. Some 12,000 new records have been received and incorporated. In August a small party of members visited the west of Ireland, successfully covering much unworked territory.* Mr. R. J. Croome and Dr. C. S. Woods of University College, Galway, gave us invaluable help during this expedition. Other noteworthy pieces of systematic mapping in 1970 were carried out by Mr. and Mrs. Rands in Kintyre and Islay, by Mr. Dance in Wales, and by Dr. Lloyd-Evans and Mr. Norris in Yorkshire.

B. Vice-county Records

The following have been verified since the last Recorder's report (*J. Conch.* 27 : 284). Unless otherwise stated, the date of collection was 1970.

Mr. J. E. Dandy's long-awaited monograph on the vice-county system has now been published (*Watsonian Vice-counties of Great Britain*, Ray Society, 1969, 2 maps + explanatory booklet, price £1.50). The vice-county boundaries (which often differ considerably from those of the modern administrative divisions) are clearly marked on a scale of 1:625,000 (10 miles to the inch), superimposed on the 10-kilometre square grid. In spite of grid mapping, the vice-county system will remain important because of the great bulk of past information classified on this basis, and if it is to remain workable it is important that Watson's original divisions be understood and strictly adhered to.

Hants South (11) : *Viviparus viviparus*, Southampton Common (pond, possibly introduced; 41/4114), P. Warris; *Pisidium tenuilineatum*, R. Test, Romsey (41/3523), M. P. Kerney.

Hants North (12) : *Aplexa hypnorum*, Burghclere (41/4963), M. R. Block.

Kent East (15) : *Pisidium tenuilineatum* (dead valve), Great Stour, Ashford (61/0143), E. G. Philp.

Norfolk West (28). *Hydrobia neglecta*, Titchwell (53/7644), R. B. Williams; *Oxychilus helveticus*, South Raynham (53/8824), Mrs. E. B. Rands; *Pisidium moitessierianum*, Gressenhall (53/9716), M. P. Kerney.

Cambridge (29) : *Azeca goodalli*, Hayley Wood (52/2952), C. R. C. Paul.

Northampton (32) : *Anodonta complanata*, R. Welland, Wakerley (42/9599), M. P. Kerney.

Monmouth (35) : *Vertigo antivertigo*, Magor (31/4286),; *Cecilioides acicula*, Cwmbran (31/2993); *Milax sowerbyi*, Cwmbran (31/2994), S. P. Dance.

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* The earlier work of Phillips and Stelfox was of course on the vice-county system. (Editor).

Hereford (36): *Acicula fusca*, Cusop Dingle (32/2440), S. P. Dance.

Warwick (38): *Clausilia rolphii*, Whichford Wood (42/2934), T. J. Crawford-Sidebotham.

Salop (40): *Agriolimax caruanae*, Oswestry (33/2929), S. P. Dance.

Glamorgan (41): *Arion lusitanicus*, Peterston-super-Ely (31/0876), S. P. Dance.

Brecon (42): *Vertigo pusilla*, Llangattock (32/2116); *Vertigo antivertigo*, Trecastle (22/8729); *Arion lusitanicus*, Felinfach (32/0933); *Agriolimax caruanae*, Cefn-coed-y-cymmer (32/0308); *Pisidium lilljeborgii*, Llwynpiod Lake, Garth (22/9550), S. P. Dance.

Radnor (43): *Vertigo substriata*, Rhayader (22/9668); *Milax budapestensis*, Llanstephan (32/1241), S. P. Dance.

Montgomery (47): *Vertigo antivertigo*, Talcenllwydiarth (22/9781); *Lauria anglica*, Pont Dol-Dwymyn (23/8204); *Agriolimax caruanae*, Llandinam (32/0288); *Pisidium lilljeborgii*, Fachwen Pool, Newtown (32/0893), S. P. Dance.

Merioneth (48): *Lymnaea auricularia*, *Planorbis laevis*, *Vertigo lilljeborgi*, Pont Croesor, Prenteg (23/5941); *Arion lusitanicus*, Corris (23/7408), S. P. Dance; *Planorbis crista*, Llyn Gwernan, Cader Idris (23/7016), L. Lloyd-Evans; *Oxychilus draparnaudi*, Maentwrog (23/6440), M. P. Kerney.

Caernarvon (49): *Vertigo lilljeborgi*, Pont Croesor Prenteg (23/5941), S. P. Dance; *Milax sowerbyi*, Llanbeblig (23/4862), S. P. Dance and A. Norris.

Denbigh (50): *Vertigo pusilla*, Llanfair-Dyffryn-Clwyd (33/1255), L. Lloyd-Evans and A. Norris; *Zonitoides excavatus*, Nantglyn (33/0061), S. P. Dance.

Flint (51): *Monacha cantiana*, Bryn-Bellau, Mold (33/2164), Mrs. N. F. McMillan.

Anglesey (52): *Limax flavus*, Beaumaris (23/6076), S. P. Dance; *Agriolimax caruanae*, Bryn-Siencyn (23/4967), S. P. Dance and A. Norris.

Lincoln South (53): *Assiminea grayana*, Saracen's Head, Holbeach (53/3327), E. J. Redshaw; *Vallonia excentrica*, Gosberton (53/23), L. Lloyd-Evans, 1969; *Anodonta complanata*, R. Witham, Tattershall Bridge (53/1956); *Pisidium personatum*, Sleaford (53/0848), Mrs. E. B. Rands; *Pisidium moitessierianum*, R. Witham, Belton (43/9239), M. P. Kerney.

Derby (57): *Pisidium supinum*, *P. moitessierianum*, Erewash Canal, Cotmanhay (43/4644), I. J. Killeen.

York Mid-west (64): *Agriolimax agrestis*, Malham Tarn (34/8966), R. A. D. Cameron.

York North-west (65): *Valvata cristata*, Croft (45/2708), R. H. Lowe.

Dumfries (72): *Agriolimax agrestis*, *Pisidium amnicum*, Hightae (35/0878); *Anodonta anatina*, Castle Loch, Lochmaben (35/0981), Mrs. E. B. Rands.

Wigtown (74): *Milax sowerbyi*, *Limax flavus*, *Agriolimax caruanae*, Stranraer (25/0660), A. Norris.

Ayr (75): *Succinea oblonga*, *Agriolimax caruanae*, Ballantrae (25/0882), A. Norris.

Peebles (78): *Planorbis vortex*, Macbiehill Pond (36/1851); *Planorbis laevis*, Whim Pond (36/2154), T. Warwick.

Roxburgh (80): *Milax budapestensis*, Teviothead (36/40), A. P. H. Oliver.

Haddington (82): *Planorbis carinatus*, *P. vortex*, Bara Wood Pond, Gifford (36/5669), T. Warwick.

Perth Mid (88): *Agriolimax agrestis*, west of Loch Rannoch (27/45), Miss S. M. Davies.

Forfar (90): *Vertigo substriata*, Glenquiech, Ogil (37/4462); *Acanthinula lamellata*, *Punctum pygmaeum*, *Agriolimax caruanae*, *A. laevis*, Airlie Castle (37/2950); *Hygromia striolata*, Morthill (37/4657); *Arion intermedius*, *A. subfuscus*, Braedownie, Glen Clova (37/2675), L. Lloyd-Evans.

Banff (94): *Milax budapestensis*, Parkmore, Dufftown (38/3341), E. Kellock.

Westerness (97) : *Vallonia excentrica*, Loch nan Uamh, Druimindarroch (17/6884); *Helicella caperata*, Camas Rubha a' Mhurain (17/6590); *Cochlicella acuta*, Rue, Arisaig (17/6283), Mr. and Mrs. E. Blezard; *Pisidium lilljeborgii*, *P. nitidum*, Loch Nostaire, Mallaig (17/6895), Dr. Shelagh Smith.

Main Argyll (98) : *Milax budapestensis*, Glen Aray, Inveraray (27/0812), Mrs. E. B. Rands.

Kintyre (101) : *Vallonia excentrica*, Kildalloig (16/7518); *Oxychilus draparnaudi*, Campbeltown (16/7122), Mrs. E. B. Rands.

South Ebudes (102) : *Vertigo substriata*, Bruichladdich, Islay (16/2660); *Retinella pura*, Ballygrant, Islay (16/4067); *Zonitoides excavatus*, Port Ellen, Islay (16/3445); *Milax sowerbyi*, *Limax flavus*, Portnahaven, Islay (16/1652); *Limax cinereoniger*, Port Charlotte, Islay (16/2557); *Pisidium obtusale*, Gruinart Flats, Islay (16/2966), Mrs. E. B. Rands.

Sutherland East (107) : *Limax tenellus*, Spinningdale (28/6689), Miss S. M. Davies.

Sutherland West (108) : *Hygromia striolata*, Durness (29/4167); *Monacha granulata*, Durness (29/3867), G. Myers.

Caithness (109) : *Agriolimax caruanae*, Thurso (39/16), R. G. Meiklejohn, 1971.

Kerry North (H 2) : *Planorbis vortex*, Upper Lake, Killarney (V 9383), G. Visser, 1969.

Cork West (H 3) : *Oxychilus draparnaudi*, Courtmacsherry (W 54), *ca* 1930; *Pisidium subtruncatum*, Skeaf (W 44), 1943, from R. A. Phillips MS.

Cork East (H 5) : *Pisidium personatum*, Ballyvolane (W 89), *ca* 1930, from R. A. Phillips MS.

Clare (H 9) : *Hydrobia neglecta*, Kilronan, Inishmore (L 8809); *Agriolimax caruanae*, Kilronan, Inishmore (L 8908), Mrs. M. Fogan and M. P. Kerney.

Tipperary North (H 10); *Pupilla muscorum*, Roscrea (S 18), 1930; *Monacha granulata*, Cloghjordan (R 98), 1908; *Zonitoides excavatus*, Mount Butler, Roscrea (S 18), *ca* 1920, from R. A. Phillips MS.

Galway South-east (H 15) : *Milax budapestensis*, Ballinderreen (M 3814), M. P. Kerney; *Agriolimax caruanae*, Kinvarra (M 3710), A. Norris.

Galway West (H 16) : *Potamopyrgus jenkinsi*, Cregduff Lough, Roundstone (L 7139), M. P. Kerney; *Planorbis vortex*, Ballyconneely (L6045), G. Visser, 1969; *Arion lusitanicus*, *Milax budapestensis*, University College, Galway (M 2925), A. Norris.

Galway North-east (H 17) : *Potamopyrgus jenkinsi*, Kilbeg Pier, Lough Corrib (M 2343); *Planorbis carinatus*, Castlegrove Lake (M 3857); *Milax budapestensis*, Claregalway Castle (M 3733), M. P. Kerney; *Agriolimax caruanae*, Carnoneen (M 4035), A. Norris.

Offaly (H 18) : *Planorbis crista*, *Pisidium personatum*, Birr (N 00), *ca* 1920, from R. A. Phillips M.S.

Kildare (H 19) : *Vertigo geyeri*, Newbridge Fen (N 71), G. Visser, 1969.

Roscommon (H 25) : *Potamopyrgus jenkinsi*, *Acroloxus lacustris*, Cloonyquin (M 88), Dr. Larch Garrad.

Mayo East (H 26) : *Potamopyrgus jenkinsi*, *Planorbis planorbis*, *Segmentina complanata*, *Acroloxus lacustris*, *Pisidium milium*, *P. subtruncatum*, *P. hibernicum*, Lough Mask, Ballinrobe (M 1564); *Pisidium personatum*, *P. obtusale*, Ballinrobe (M 16); *Anodonta cygnea*, Lough Mask, Partry (M 1471), M. P. Kerney; *Columella edentula*, *Lauria anglica*, *Acanthinula lamellata*, *Punctum pygmaeum*, Cong (M 1454), A. Norris; *Balea perversa*, Ballinrobe (M 1865); *Vitrina pellucida*, Ballinrobe (M 1764), M. P. Kerney; *Milax budapestensis*, *Agriolimax caruanae*, Cross (M 1955), Mrs. M. Fogan and A. Norris; *Helicella virgata* (dead shell), Kilmaine (M 2460), Mrs. M. Fogan; *Limax maximus*, *L. flavus* (dark form), Kilmaine (M 2460), R. J. Croome.

Mayo West (H 27) : *Vertigo lilljeborgi*, Partry (M 1473), R. J. Croome and M. P. Kerney.

The following segregates of *Carychium*, *Cochlicopa* and *Vitrea* have also been verified :

Carychium minimum : 47, 90, 101, H 16, H 17, H 26, H 27.
Carychium tridentatum : 90, 92, H 16, H 17, H 26.
Cochlicopa lubricella : 90, 101, H 16, H 17.
Vitrea crystallina : 21, 72, 80, 92, H 16, H 25, H 26.
Vitrea contracta : 53, 92, H 16, H 26.

The following records are to be deleted from the Census :

Acanthinula lamellata : 51. No confirmation can be traced.

Pisidium henslowanum : 109 (Loch of Mey, C. Oldham, 1927), 112 (Hellier's Water, Unst, C. Oldham, 1928); see *J. Conch.* **19** (1932) : 271. My attention was drawn to these geographically very isolated records by Mr. J. G. J. Kuiper, who suspected that they might be errors for *Pisidium lilljeborgii*. An examination of the specimens (Oldham collection, British Museum (Natural History)) by Mr. Kuiper and myself bears this out. The Loch of Mey shells misled Oldham because many possess appendiculae, a feature in fact characteristic of the rare var. *cristata* Sterki of *P. lilljeborgii*. The two specimens from Unst are fairly normal *P. lilljeborgii*, and not inappendiculate *P. henslowanum*, as Oldham thought.

Perhaps the most important find of the past year has been Mr. Dance's discovery of *Vertigo lilljeborgi* in north Wales. The principal locality, where it is common, is a fen on the Caernarvonshire side of the Afon Glaslyn, in a place subject to heavy flooding during spates to a depth of several feet (a single example was also found on the Merionethshire side of the river, a few hundred yards away). In view of the interest attaching to this isolated colony of a north-western glacial relict species, Mr. Dance hopes that the site can be put under the protection of the Nature Conservancy.

In Ireland, Mr. Visser has found a new locality for *Vertigo geyeri* Lindholm (*V. genesii* of British authors) at Newbridge Fen, Co. Kildare, a calcareous bog with *Schoenus nigricans*. Unfortunately, the habitat is being destroyed by drainage, and it is becoming apparent that most, if not all, of the very few known Irish sites for this relict species are threatened in the same way. For example, it seems to be now extinct in at least two of the five localities in the Central Plain described by R. A. Phillips in 1935 (*J. Conch.* **20** : 142).

The new Yorkshire locality for *Agriolimax agrestis* helps to link the Scottish distribution with the isolated Norfolk sites. The species has been verified from two further Scottish vice-counties.

Monacha cantiana has rather surprisingly turned up in Flintshire. The habitat, a disused sandpit, suggests recent colonization.

Arion lusitanicus has been found in Glamorgan, Brecon, Merioneth and Galway West. It was looked for carefully in Ireland, but is evidently not common. The Galway habitat was a piece of disturbed waste ground, where it occurred freely with *Milax budapestensis* and other synanthropic species.

Two further Welsh localities for *Vertigo pusilla* are worth noting, in both cases on walls. *Succinea oblonga* from Ballantrae verifies an ancient Ayrshire record.

Among the freshwater species, several new records of *Planorbis vortex* are of interest. This essentially lowland species becomes rare to the north and west, where *Planorbis leucostoma* has in the past often been mistaken for it. For this reason the present specimens have been checked with special care, but all seem to be correctly named, and the habitats as described also fit this species rather than *P. leucostoma.*

Among *Pisidium*, Mr Dance has extended the known range of *P. lilljeborgii* in central Wales, and the rare *P. tenuilineatum* can be added for Kent East and Hants South.

Hydrobia neglecta can now be listed for the first time from Ireland. The little brackish pool in which it lives at Kilronan (Aran Islands) has in fact been known for very many years as a locality for *Hydrobia "ventrosa"* (Stelfox, *Ir. nat.* **16** (1907) : 361).

M. P. Kerney

RECORDER'S REPORT : MARINE MOLLUSCA

The sad news of the death of Mr. L. W. Stratton, Chairman of the Marine Census Subcommittee, came whilst this report was being drafted. Only a month previously he had helped with queries about the development of the Census work, showing his unwavering interest and readiness to help despite his illness.

10-kilometre square mapping

Following overtures from the Biological Records Centre to the Council last spring, it was agreed that information collected for the Society's Marine Census should be centralized at Monk's Wood for the purposes of 10-kilometre square mapping recording, although all records would continue to be filtered through the Recorder, and the Marine Census Area recording would be unaltered (see *Conch. Newsletter* No. 34). It can now be reported that the species files are in process of being photocopied at the B.R. Centre, and that carbon copies will be taken of future entries so that these can be sent to Monk's Wood at intervals. Meanwhile a Regional Record Card is being prepared with the advice of the Marine Census Subcommittee. It is planned to have virtually all of the ca. 600 marine species listed in abbreviated form on a single folding card : the numbers, sequence and names will follow Winckworth's well-known list, on which all recording has been based up to the present. With one of these cards it will be possible to record the molluscan fauna of a particular habitat, a whole beach, or a complete 10-kilometre square by simply marking through the names of the species found, as is done in the non-marine mapping scheme. The usual symbols will be added as appropriate to indicate whether the species was found living (A), represented by shells alone (B) or, if the shells are worn, C.

Census Area records

The following notes name those who have submitted lists and, where necessary, specimens for verification or for the Voucher Collections, since February 1970. New records are given only for those Areas for which reasonably complete lists have been compiled.

Shetland (C.A. 1) : Mrs. N. F. McMillan.

Firth of Forth (C.A. 7) : Dr. J. D. Peacock; Dr. Shelagh Smith (plus Voucher specimens); J. Worsfield (per L. D. Harfield and Dr. S. Smith). Dr. Smith is compiling a comprehensive list for C.A. 7, and already both published and unpublished sources she has increased the former list by about 100 species to close on 300 species.

Yorkshire (C.A. 11) : Dr. R. Seaward .

Wash (C.A. 12) : D. A. J. Taylor; R. B. Williams (plus Voucher specimens).

Thames (C.A. 13) : Rev. H. E. J. Biggs; R. B. Williams (plus Voucher specimens).

East Channel (C.A. 14) : G. Dinesen; Dr. Joan Llewellyn Jones. Dr. Llewellyn Jones forwarded the results of the Field Meeting to Camber on the 15 March 1970, together with other lists made in 1969 and 1970. The following were new to the compilation for the Area, based largely on Winckworth, 1920 (The marine Mollusca of Sussex. *J. Conch.* 16 : 89–95). G.71 *Rissoa parva* (da Costa "B"; G.80 *Skeneopsis planorbis* Fabricius "B"; G.105 *Graphis albida* (Kanmacher) "B"; *Thracia phaseolina* (Larmarck) "C".

Wight (C.A. 15) : G. Dinesen; Dr. Joan Llewellyn Jones; John Llewellyn Jones; D. R. Seaward; D. A. J. Taylor; R. Warris.

Portland (C.A. 16) : G. Dinesen; Dr. Joan Llewellyn Jones; John Llewellyn Jones; J. Murray (per Dr. S. Smith); G. H. Pitchford; D. R. Seaward; P. Warriss.

Channel Isles (C.A. 17) : A. Featherstone.

West Channel (C.A. 18) : G. Dinesen; Mrs. J. Charlish; G. H. Pitchford (plus Voucher specimens).

Isles of Scilly (C.A. 19) : John Llewellyn Jones; D. A. J. Taylor. A list of ca. 330 species has now been compiled for C.A. 19; Flt. Lt. Taylor and Mr. Llewellyn Jones have upgraded several, some of them being new 20th century records. A completely new record for this Area, so well-worked in the last century, is G.124 *Pelseneeria stylifera* (Turton); two examples were collected by Flt. Lt. Taylor from urchins (*Echinus esculentus*), of which 120 specimens in all were examined by members of the R.A.F. Sub Aqua Club expedition in a search for ectoparasitic molluscs. One of the two specimens of this rare species has been donated to the Voucher collections.

Bristol Channel (C.A. 21) : A. Lewis; G. W. Pitchford; D. A. J. Taylor (plus Voucher specimens); P. Warriss. The following are new to the Area : G.67 *Alvania punctura* (Montagu) "B"; G.125 *Chrysallida obtusa* (Brown); G.133 *Menestho divisa* (J. Adams) "B"; G.135 *Menestho obliqua* (Alder) "B"; G.228 *Philbertia linearis* (Montagu) "B". The foregoing species were taken at Martin's Haven in the Dale Fort district, and are additions to the Dale Fort Fauna, 1966 (*Field Studies* 2 : Supplement). The following species, also found at Martin's Haven, although not new to the Area, have not hitherto been reported from Dale Fort (10 km. square 12/80). All of these specimens were found by Flt. Lt. Taylor during dives with the St. Athan R.A.F. Sub Aqua Club. G.78 *Tornus subcarinatus* (Montagu) "B"; G.128 *Chrysallida decussata* (Montagu) "B"; G.131 *Chrysallida spiralis* (Montagu) "B"; G.238 *Retusa retusa* (Maton & Rackett) "B".

Cardigan Bay (C.A. 22) : Mrs. A. M. Brockbank; T. Cawley (per D. A. J. Taylor); Mrs. J. Charlish; Mrs. H. Nash; D. R. Seaward. A consolidated list for this Area was presented in *Conch. Newsletter* No. 34. Since then a valve of L.159, *Zirfaea crispata* (L.) has been submitted by Mrs. Charlish so adding authenticity to the report of the species by J. J. Cotton.

Liverpool Bay (C.A. 24) : L. D. Harfield; Dr. Joan Llewellyn Jones; Dr. S. Smith. Dr. Llewellyn Jones sent the results of a Field Meeting to Southport (34/31) for which the total number of species is now 55 (see *Conch. Newsletter* No. 34). The following addenda and corrigenda pertain to the list in *Conch. Newsletter* No. 29 : G.5 *Punctuella noachina* (L.), for which Marshall, 1898 *J. Con.* 9 : 67) gives "Liverpool Bay (Tomlin)" but there is no indication that this species, whose known range is Scotland and the north-east England, was found alive; G.34a *Skenea millipunctata* (Friele), for which Chaster and Heathcote, 1894 (*J. Conch.* 7 : 301) state "Mr. J. T. Marshall found an example in drift from Southport shore"; G.26 *Gibbula umbilicalis* (da Costa) should be category "b" because the species has not been found in the Area this century, and has probably never been found there alive (see McMillan, 1959 *Rep. Lancs. Chesh. Fauna Soc.* No.

31). G.234 *Janolus hyalinus* (Alder and Hancock) should be "a" not "A", as it is based on a 19th century report; G. 76 *Assiminea grayana* Fleming must be deleted, and my thanks are due to Mrs. M. Fogan for drawing attention to this; G.107 *Aclis minor* (Brown) can be upgraded from 'b' to 'B' (shell sand, Blackpool, August 1968, P. Cambridge); G.111 *Eulima glabra* (da Costa) upgraded from "C" to "B" (Blackpool, August 1968, P. Cambridge); L.96 *Dosinia lupinus* (L.) "B", upgraded from "C" (Field Meeting to Southport, April 1969); L.142 *Spisula elliptica* (Brown) "B", upgraded from "C" (Field Meeting to Southport, April 1969).

Solway (C.A. 25) : L. D. Harfield; Dr. S .Smith.
Isle of Man (C.A. 26) : Dr. S. Smith.
Clyde and Argyll (C.A. 29) : Miss B. Rae; M. Rose; Dr. S. Smith.
Minch (C.A. 30) : L. D. Harfield; J. D. Peacock; Dr. S. Smith (plus Voucher specimens).
Uist (C.A. 32) : D. W. McKay; Dr. J. D. Peacock; R. S. Scott, recording molluscs for Leicester University Expedition to the Monach Islands (plus Voucher specimens).
North Donegal (C.A. 33) : Dr. J. D. Duffus; Dr. C. Edwards (per D. Heppell).
Galway Bay (C.A. 36) : Mrs. A. M. Brockbank (plus Voucher specimens).
Fastnet (C.A. 37) Mr. A. Bromley (per Mrs. A. M. Brockbank); Mrs. N. F. McMillan.

Thanks are due to Mrs. J. Charlish who has helped some members with the identification of the more difficult species before they submit lists, to Mrs. D. Taylor who helped her husband pick out tiny species from pounds of bottom debris, and to Mr. H. B. Sargent who spent a great deal of time sorting both debris and then the shells. Since last year three new members, Dr. Shelagh Smith, John Llewellyn Jones and Charles W. Pettit have been co-opted on to the Marine Census Subcommittee. I would like to thank them, and the founder members of the Subcommittee, especially Mrs. N. F. McMillan for much help and advice. I would also like to express appreciation of the very ready help I have received from Dr. F. H. Perring of the Biological Records Centre.

Stella M. Turk

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J. Conch. **27**: 451 (1972)

CORRECTIONS TO J. CONCH. Vol. 27, No. 4

It is regretted that legends for illustrations to Dr. Shelagh Smith's paper on "*Rissoa violacea* Desmarest, *Rissoa lilacina* Récluz, *Rissoa rufilabrum* Alder and *Rissoa porifera* Lovén and their distribution in British and Irish waters" were omitted. Details are as follows:

Text-fig. 1. Map of Great Britain and Ireland showing the localities from which samples of *Rissoa* were obtained. a, Isle of Wight; b, Torbay; c, Scilly Isles; d, Cardigan Bay; e, Isle of Man; f, Bantry Bay; g, Galway; h, Donegal; i, Clyde; j, Skye; k, Wester Ross; l, Shetland.

Squares indicate *R. lilacina*; diamonds, *R. rufilabrum*; circles, *R. porifera*. In black over 100 specimens; half black 50–100; crossed, 10–50; plain, less than 10.

Text-fig. 2. Variation diagram of *Rissoa* to show the ratio of the number of ribs per whorl to the apical angle. Area enclosed by solid line *R. violacea*; by dashed line *R. lilacina*; by dash-dotted line forms intermediate between *R. lilacina* and *R. rufilabrum*.

Plate VIII reads as Pl. I in the text.

a, *R. variabilis*; b, *R. decorata*; c, d, *R. guerinii*; e, *R. ventricosa*; f, *R. plicatula*; g, *R. frauenfeldiana*; h, *R. aurantiaca*.

Plate IX reads as Pl. II in the text.

i, j, *R. violacea*; k, l, *R. lilacina*; m, n, *R. rufilabrum*; o, *R. splendida*; p, *R. porifera*; q, *R. rufilabrum* var. *paucicostata*.

The unnumbered plate following Pl. XI is that of Dr. Zeissler's paper "On *Fagotia acicularis* (Férussac) from the quaternary deposits in the valley of Helme and Unstrut". Legend for the plate:

Fagotia acicularis (Férussac).

(1) From Kalbsrieth, in the same state as the specimens from Edersleben and Zeuchfeld figured by Wüst.

(2) From the upper (Mindel) stratum of the calcareous tufa of Vertesszöllös, intact but bleached.

(3) From the early Wurm calcareous tufa of Tata, intact and less bleached than no. 2.

(4) "Subfossil" shells from the Danube sand of Báta, broken, worn and eroded, in the same state as those of Thuringia as well as marine tertiary shells from the same sand-sample.

(5) Shell from the same sample as no. 4, but not so bleached and not eroded, evidently not so old.

All specimens ca. × 7,7 enlarged. Phot. Elke Knauff, Weimar.

Legend for Fig. 1 of Dr. Zeissler's paper was unfortunately omitted. It should read: Map of *Fagotia acicularis* (Férussac) sites on the rivers Helme and Unstrut. Altitudes given summarily after the DDR Isohypse Map and show that Bottendorf and Rossleben deposits with northern rocks belong to a lower Unstrut terrace. Exact altitudes above sea-level cannot be given. Wüst gives them in feet after the old geological maps, but only for the lower and upper margins of the whole series of deposits. During the last investigations of the Pleistocene deposits of Voigtstedt (Edersleben) the *Fagotia*-stratum was not opened.

The Hon. Treasurer has drawn attention to a misprint in the Accounts, the figures under the heading "Publications" should read:

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Department of Zoology, University of Reading, England

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THE AMPULLARIIDAE, AN HISTORICAL SURVEY

T. Pain

47 Reynolds House, Millbank, London S.W.1

(*Presidential Address delivered* 27 *February* 1971)

Although not popular with collectors, for reasons that are obvious to anyone who has handled them, the family Ampullariidae, which contains the largest of all freshwater gastropods, forms a very conspicuous element in the molluscan fauna of tropical regions in both the new and old worlds.

Their fossil record is scanty and confined to areas in which the family is still found living. Earliest definite records are from the Lutetian (Mid-Eocene) of the Faiyum of Egypt and from the Miocene of Kenya. Material from the Cretaceous of the south of France referred to this family, has since been shown to belong to *Natica* (s.l.). Only a single extinct species of the hyperdextral genus *Lanistes* occurs in the Eocene of Egypt (*L. antiquus* Blanckenhorn, 1901) probably representing the ancestral form of *L. carinatus* (Olivier), the common living representative of the genus in the Nile valley, which is also found in the Miocene of Kenya, together with *Pila ovata* (Olivier). Both these species are found living in the area, a tribute to the longevity of the family in East Africa.

In India, the occurrence of subfossil opercula of *Pila* in Kashmir on which Prashad (1925) based a new species *P. prisca*, points to a greatly extended range for this family within the Indian subcontinent in former times. In Africa also, Pleistocene deposits in the Sahara containing *Pila* indicate a far wider range northwards than exists today, the genus now being confined in North Africa to the Nile valley.

As already mentioned this family is entirely confined to tropical areas. In America its range extends from central Mexico to the La Plata system, one species occurs in Florida and Georgia and a few are found in the West Indies. In Africa it extends along the Nile into Lower Egypt and is most abundant in the eastern and central portions of the continent. In West Africa it does not appear to have been found to the north of Lake Chad and the Niger. In South Africa the southernmost records are from Damaraland and Bechuanaland in the west and the mouth of the Zambezi in the east. Two species are known from Madagascar. Within the Oriental region Ampullariidae occur in Ceylon, India, basin of the Ganges, Burma, Thailand, Malaya, and the islands of the Malay Archipelago, as far east as Bali and the Celebes and northwards to the Philippines.

It does not occur in New Guinea, the Pacific Islands, Australia or China. It is entirely absent from the Palaearctic Region (except Lower Egypt).

The animal is amphibious. When it is completely immersed, respiration may be wholly branchial; when out of water, directly pulmonary. Ordinarily it obtains air by occasional visits to the surface, exactly like Lymnaeid snails. Most of these snails prefer low marshy banks of rivers, swamps, ponds or lakes to running water. Many of them are able to stand prolonged desiccation.

The globular eggs have a calcareous shell and are deposited in clusters on reeds somes inches above the surface of the water.

The classification is based chiefly upon characters of the shell and operculum, since the soft parts are still unknown in a majority of the species, among them all those belonging to the groups *Saulea*, *Afropomus* and *Limnopomus*. The interrelations and to some extent the limits of the genera are not well understood. The major divisions are somewhat artificial, for want of knowledge of these three groups.

By external characters these snails may be grouped into longisiphonate forms, including the American groups *Pomacea* and *Marisa,* and brevisiphonate, comprising the American *Asolene* and *Pomella*, and the Old World genera *Pila* and *Lanistes* with its subgenera *Meladomus* and *Leroya.*

The radula is singularly uniform throughout the family, and at present it appears doubtful whether it differs in any constant features in the three main genera, *Pila*, *Pomacea* and *Lanistes.*

The Ampullariidae appear to have attracted the attention of travellers as far back as the 17th century, at any rate Martin Lister (1685–1692) figures three common South American species, *Pomacea urceus* (Müll.), *P. guyanensis* (Lam.) and *P.* (*Effusa*) *glauca* (L.). There are perhaps the earliest "Ampullaria" figures extant.

Rumphius (1705), Seba (1734–1765) and Gaultieri (1742) all gave rough figures of shells which appear to belong to the family. Those of Rumphius and Seba are reversed, apparently due to the carelessness of the engraver, the sinistral shell thus artificially produced by these ancient authors is perhaps rarer in the Ampullariidae than in almost any other family, if we exclude the apparently sinistral (hyperdextral) genus *Lanistes.* Only three examples are on record, two from India, one specimen each of *Pila orbata* (Perry), and *P. carinata* (Swainson), and one from Africa, *P. wernei* (Phil.).

Linné seems to have regarded the Ampullariidae as terrestrial, since he referred the common oriental species *Pila ampullacea* to the genus *Helix* !

D'Argenville (1757), Martini and Chemnitz (1769–1795), Knorr (1771), Müller (1773), Schröter (1779), all figured *Ampullaria*, under various names, mostly referring them to *Helix*, and Müller putting his *A. urceus* in *Nerita.*

Humphrey (1797) noted five species under the name *Pomus*, the first attempt to erect a generic name for these shells. Acording to Dall (1904) Humphrey's work was published anonymously, was not issued for sale, bears neither the name of the author or publisher and is invalid under the rules of nomenclature. No diagnosis or figure was given or cited. Of these "species", only one, *P. ampullacea* from China is identifiable, this is the *Helix ampullacea* of Linné. The locality "China" is certainly erroneous.

The following year Röding (1798) created the genus *Pila* for these freshwater snails and divided the forms commonly included under *Helix ampullacea* L. into six species, retaining the name *ampullacea* for one of these and this was subsequently selected as the type of the genus by Dall (1904). Although no diagnosis was given, full citation of name, volume, page and figure of previous authors was provided and therefore fulfils all requirements under the rules.

A year later, in 1799, Lamarck published the generic name *Ampullaria*, with the sole example cited, *Helix ampullacea* L. and in this connection some revision of Dall's (1904) conclusions appear called for. He argues that by "*Ampullaria ampullacea*", "le cordon bleu", Lamarck intended to indicate *Nerita urceus* Müller, because two years later he aded the words, "muni d'un opercule corne"! This is pure assumption; in many cases an author has subsequently amplified his generic diagnosis by adding characters from additional species, and this is obviously what Lamarck did. So far as I have been able to learn *N. urceus* was never known as "le cordon bleu". I agree with Pilsbry that in cases where an author bases a genus upon a described species and there is nothing in the original diagnosis to show that he meant something else, neither he nor any other author has the right to shift the generic name to any other genotype. *Ampullaria* Lamarck, 1789 therefore becomes a synonym of *Pila* Röding, 1798, both having the same type. Since the type species of the genus *Pila* has a calcareous operculum a feature common to all the Old World Ampullariidae with the exception of the two West African genera *Saulea* Gray, 1867 and *Afropomus* Pilsbry and Bequaert, 1927 in which this appendage is corneous, *Pila* is now restricted to the Old World Species, those from the Americas being placed in the genus *Pomacea* Perry. March, 1810 the type of which, *P. maculata* Perry, comes from Brazil and is the largest species known. In the New World genera the operculum is corneous.

The first really important contribution to the study of the Ampullariidae came from the pen and brush of William Swainson in his two series of *Zoological Illustrations* (1820–1823 and 1829). He had previously noticed some of them in Tilloch's *Philosophical Magazine*, but the new descriptions were enriched with exquisitely drawn and coloured figures. Swainson was however one of the dry-as-dust school of naturalists, the text of the first series is so abbreviated as to be unreadable as is that of the second by reason of the author's obsession with the notorious "circular system" of classification. But as a zoological artist he has perhaps never been equalled and his figures of "Ampullaria" are absolutely faithful both in respect of detail and colour and are a delight to the eye.

The mollusca collected in Brazil by J. B. Spix were published in 1827 at Munich, in a thin folio, the text of which is in Latin. A number of new species of *Pomacea* were described and figured in this work, the illustrations although of natural size are rather rough both in design and colour. It is of interest to note that the species already described and figured by Perry in 1810 as *P. maculata* was again published as a new species under the name *Ampullaria gigas* by which it has continued to be known until the present time.

In 1802 a paper by the Rev. Lansdown Guilding appeared in the third volume of the *Zoological Journal*; in this paper an effort was made to discriminate on anatomical grounds betwen species with calcareous opercula (*Pila*) and those in which this appendage is chitinous (*Pomacea*). Guilding was able to show that the animal is brevisiphonate in *Pila*, longisiphonate in *Pomacea*.

Alcide d'Orbigny's elaborate work on his South American travels was published between the years 1834 and 1847, the volumes dealing with the mollusca appearing in 1839. The species of *Pomacea* occuring in the La Plata river system were dealt with in detail for the first time.

A German, Robert Schomburgk who had been employed by the British Government to carry out exploration in British Guiana, made extensive collections, and the Mollusca he obtained were reported upon by Troschel (1848). Schomburgk stated that his collectors paid special attention to the Mollusca, but the results were disappointing, which proved to be my experience also, when collecting in the same area nearly 100 years later. Nevertheless in spite of his meagre results Schomburgk gives useful notes on the localities and habits of the *Pomacea* he obtained which proved of great value to those who have followed him in Guiana.

The year 1857 saw the publication of the first monograph devoted to the Ampullariidae. The author was R. A. Philippi and his work appeared in the second edition of Martini and Chemnitz' *Syst. Conch. Cab.* His material was obviously poor both as regards quality and quantity, as is demonstrated by the number of damaged and uncoated specimens figured. The plates, 22 in number, are somewhat crude and the colouring as it appears in most copies leaves much to be desired. Nevertheless in spite of these drawbacks Philippi showed how to make the most of his poor material by his careful attention to shell characters, and errors are few. He does, however, make d'Orbigny's *P. insularum* from La Plata a synonym of the quite different *P. gigas* (Spix) (= *P. maculata* Perry) from Brazil, and it is apparent that he had never seen the latter species. Figures of living animals of South American *Pomacea* make up plate "A" of this work and having collected examples of all the species figured, I can vouch for the accuracy of them. It is to be regretted that no *Pila* were included for comparison.

In 1854 the first three parts of Sylvanus Hanley's *Conchological Miscellany* appeared, a mixture of hitherto unpublished plates by G. B. Sowerby, with some additions lithographed by T. Hall. Under the latter came four plates of *Ampullaria* in the first part. Unfortunately no descriptions were given, nothing more than the name and an occasional line of comment. A number of little known and critical species were however figured for the first time. Copies of this work with plain plates tend to give more characteristic figures of the shells illustrated than those that have been coloured, these suffering from the rather crude method employed.

In the same year Ludwig Pfeiffer began the issue of his *Novitates Conchologicae*

Series One. He had been resident in the island of Cuba and besides a general discourse on the Ampullariidae, described three species from that island. His attempt to illustrate the Cuban species was however far from successful, *Pomacea reflexa* (Swainson) from Columbia and *Pila conica* (Wood) an East Indian species being included.

The second of the two great monographs devoted to the family was the work of Lovell Reeve, in the 10th volume of the now famous *Conchologica Iconica.* This part of the work appeared in 1856. The following year it was severely criticised by Von Martens, who called it a mere picture-book for the purpose of identification. It is certainly true that "Iconica" was intended to have strong popular appeal, being devised to help amateurs at a time when shell collecting was enjoying a period of great popularity. It is likewise undeniable that these descriptions, bearing in mind the special difficulties inherent in this family, are far too loose and abbreviated. They would be of little service if they stood alone. However Reeve was supported by one of the most accomplished artists that ever drew the portrait of a shell, namely G. B. Sowerby II, whose figures are so accurate and characteristic that the descriptions can almost be dispensed with. Perhaps the only major fault one can find with this work is the fact that Reeve completely ignores several well established species described by Philippi and others. It is thus somewhat incomplete, but at the same time has greatly enriched the science by the publication of a long series of new species many of which have stood the test of time, chiefly from the magnificent collection of Hugh Cuming and now preserved in the B.M.(N.H.). A few obvious mistakes appear, apparently caused by erroneous locality data attached to the specimens. *Pomacea dolioides* (Rve.), a very abundant inhabitant of canals in Guiana is ascribed to Bombay and *P. erythrostoma* (Reeve), a synonym of *P. guyanensis* (Lam.) from northern South America is said to be from Zanzibar! both errors which have persistently been included in later works. Both Von Martens and Alderson complain that Reeve makes no mention of the operculum as an indication of Eastern or Western habitat, in fact he does not mention the appendage once in any of his descriptions, in spite of the very extensive material from a wide range of localities at his disposal. He has, however, caused the artist to represent it "in situ", to the detriment of his figures.

The zoological results of Count Castelnau's South American expedition were published in three sumptuous volumes, the last of which contained a report of the mollusca and appeared in 1857. It was the work of J. R. Hupé who was apparently unacquainted with the monographs of either Philippi or Reeve, since he never refers to either. At any rate several of his new species of *Pomacea,* of which there are four excellent plates, bear a suspicious resemblance to species described by Reeve in the previous year.

Henry Drouët, who had visited French Guiana, published in Paris in 1859, a small volume on the land and freshwater mollusca of that country, which included some interesting information of the numerous *Ampullaria* occuring there.

1863 saw the publication of J. R. Bourguignat's account of the Ampullariidae of Egypt. It almost goes without saying that he took the opportunity to describe as new species a number of forms of the variable Nilotic *Pila ovata* (Olivier).

Von Martens' admirable work on the inland mollusca of Venezuela appeared in 1873 and contained extensive and valuable notes on the Ampullariidae occurring there. Another equally important contribution to the literature was produced in the same year, by Strebel and Pfeiffer, dealing with the non-marine mollusca of Mexico. Pfeiffer was responsible for the anatomical work, the purely conchological department being Strebel's. The latter's personal experiences in the field was unfortunately very limited, being confined to the neighbourhood of the city of Vera Cruz, but his observations so far as they went were sound. Being a capable draughtsman he also contributed two plates of *Pomacea*, one showing the animal and eggs, the other a series of outlines lightly filled in, to illustrate the forms of that most difficult species, *Pomacea malleata* (Jonas) (= *flagellata* (Say)).

Morelet in 1875, discussed several species of Oriental *Pila*, on which, as on all land and freshwater molluscs he was a commanding authority, and the next year appeared Hanley and Theobald's *Conchologica Indica.* A work like Reeve's "Iconica", consisting of coloured plates and very abbreviated descriptions. The three plates dealing with the Indian *Pila* are good, but on the whole they do not show Sowerby's draughtsmanship at its best, and one or two of the identifications are certainly open to question. It is, however, the first and only attempt to produce a comprehensive survey of all the species known from greater India and to illustrate them adequately and is most valuable on this account.

In 1877 Geoffrey Nevill published his catalogue of the mollusca in the Indian Museum, Calcutta, which was followed by his *Hand List* of the same collection, published in two parts, 1878 and 1884. These works contain many notes on the Ampullariidae which are fully dealt with in part two of the *Hand List.* The Indian Museum was apparently not well off for American species, but his remarks on the Oriental *Pila* are most useful.

African Ampullariidae again engaged the attention of Bourguignat in 1879 when he published his account of the mollusca of Egypt, Abyssinia and Zanzibar. A further important work on African species followed in 1885, the work of René Billotte on material from Somaliland. A third attempt to catalogue the African species was made by Bourguignat in 1889 when he revised the mollusca of Equatorial Africa, and needless to say described many new species of which only one, *Pomacea letourneuxi*, has so far stood the test of time. The year 1897 saw the publication of Von Martens' most useful work on the non-marine mollusca of German East Africa, in which a full account of the Ampullariidae occurring there is given, with precise locality data. Both Bourguignat and Von Martens again repeated Reeve's mistakes as to the habitat of his *Pomacea erythrostoma*, an error which has proved itself very tenacious of life.

The end of the 19th century, saw the publication of two very important works, one due to public the other to private enterprise. The results of the French

Scientific Expedition to Mexico and Central America were published by order of the French Government and the molluscan portion of this was entrusted to M. M. Crosse and Fischer. This work was begun in 1870 and not completed until 1902. It is, therefore, rather difficult to put this colossal publication in its strict chronological place, but the part containing the Ampullariidae, which extends from page 218 to page 252 inclusive of the 2nd volume seems to have been issued in 1890. Three of the four plates devoted to shells had appeared with the previous part in 1888. These plates are exquisitely lithographed and coloured in the best style of French zoological art. The text is a model of its kind and the whole work forms a classic in the history of land and freshwater mollusca.

Godman and Salvin's monumental *Biologia Centrali-Americana* contained a volume on the non-marine mollusca of the region, then being dealt with by Crosse and Fischer. This work like its bulkier companion, progressed very slowly and occupied Von Martens from 1890 to 1901. The parts containing the Ampullariidae were published in August and September 1899. The shells are illustrated on three plates, which are perhaps the least admirable part of the work. Von Martens' descriptions are excellently done, although some of his identifications of species of Reeve and others are doubtful.

The present century opened with the publication of three important papers by G. B. Sowerby III (1908, 1909, 1916). The first deals with the genus *Pomacea*, *Pila* followed in 1909 and *Lanistes* in 1916. Sowerby listed all the Ampullariidae known and described up to that time, and this, together with his notes on them, have proved of great value to all subsequent workers.

The dealer H. B. Preston was responsible for the volume on Freshwater Mollusca in the *Fauna of British India* series. His work is a pure compilation, but is of practical help if used in conjunction with the "Conch. Indica.", whose meagre notes on shells it supplements.

In spite of the effect of the First World War, the year 1915 saw the final publication of the most complete and detailed monograph of the Ampullariidae ever attempted. This was the work of Dr. W. Kobelt and appeared in the new series of Martini and Chemnitz, *Syst. Conch. Cab.*, commenced in 1911. Original descriptions, together with synonymies and constructive comments are given and the plates are excellent. When Kobelt was not in possession of actual specimens he reproduced original figures. Errors are few, but Reeve's *Pomacea erythrostoma* once again appears with the locality Zanzibar, and the same authors *P. dolioides* is doubtfully refered to Bombay. In the mistaken belief that *Nerita urceus* Müll. had been selected by Lamarck as the type of his genus *Ampullaria*, Kobelt uses this generic name for the New World species and *Pachylabra* Swainson, a synonym of *Pila* Bolten for those from the Old. Nevertheless the work still stands as the major contribution to the study of this difficult family.

The year 1925 marks another milestone in the history of the Ampullariidae, with the private publication of E. G. Alderson's *Studies in Ampullaria*. Ellerton Garside Alderson, a well-to-do country parson, had a fine private collection and had long wished to monograph the entire family, but having resolved to use for his researches only material in his possession and the advent of the First World War making it impossible to obtain more, he was obliged to confine his work to the species represented therein, and *Studies in Ampullaria* was the result of this. Alderson declined the use of borrowed or museum material, rightly claiming that this was never to hand when most needed. Just the same, his work, as far as it goes, is of great practical help to all workers on this group. A useful survey of the literature is given, as well as suggestions as to the best method to identify specimens. Many much misunderstood species such as Reeve's *erythrostoma* are correctly localised for the first time, and detailed synonymies for all the species dealt with are given. Alderson chose for purely personal reasons to use Lamarck's familiar name *Ampullaria* for both Old and New World species, but this in no way detracts from the overall usefulness of this remarkable work. No mention, however, is made of Kobelt's monograph, which was for some inexplicable reason unknown to Alderson.

The edition was limited to 150 copies of which the plates of 15 were coloured by the author. These plates, both plain and coloured are in every way excellent and it is of interest to note here that a further plain copy has since been coloured by Mrs. W. Crowley and is if anything superior to the original 15 !

The species occurring in Siam were reviewed and illustrated by N. Annandale (1920). Useful details of the habitats, as well as descriptions of the animals and the radula are given, an aspect so often ignored in many earlier works.

In 1927 H. A. Pilsbry dealt with the *Pomacea* of the islands of Cuba and Jamaica, and in the same year this author, in conjunction with J. C. Bequaert, revised the species of *Pila* and *Lanistes* occurring in the Congo, as well as furnishing a most useful list of the species that have been described from Africa.

Since the Second World War numerous papers on the non-marine mollusca of selected areas within the tropics have appeared, dealing in detail with the Ampullariidae. Those of Java by W. S. S. van Benthem Jutting, 1956, Lake Tanganika by E. Leloup, 1953, Lake Victoria and adjoining areas of Uganda by G. Mandahl-Barth, 1954, a revision of the African species by Pain, 1961, Lake Nyasa by Crowley and Pain, 1964, and Lakes Mweru and Bangweulu by Mandahl-Barth, 1968.

In the New World, the *Pomacea* inhabiting Argentina and Uraguay have been revised by M. I. Hylton Scott, 1957, those from British Guiana by Pain, 1956, Venezuela by Pain and Arias, 1958, the Amazon region by Pain, 1960, Central America from Mexico to Panama by J. C. Bequaert, 1957, and Guatemala by Pain, 1964.

In spite of this spate of post-war publications much still remains to be done, especially in respect of the animal which has been investigated in less than a quarter of the 70 or so species described. It is to be hoped that future malacologists will turn their attentions to this neglected aspect of the study of the Ampullariidae and that an improved classification of this important group of freshwaer Prosobranchs will result.

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STUDIES ON VARIATION AND LIFE HISTORY IN THE PROSOBRANCH *HYDROBIA ULVAE* (PENNANT)

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INTRODUCTION

Hydrobia ulvae (Pennant) is a small prosobranch mollusc which lives in large numbers on tidal salt-marshes and mud-flats and is to be found in most coastal areas of the British Isles where these suitable conditions prevail.

Most of the data assembled in this paper are the result of work from 1965 to 1969, and mostly concern *H. ulvae* populations along the North Kent coast (Fig. 1) at Seasalter (Nat. Grid. 61/074651), Whitstable (61/104665), Herne Bay (61/157683) and Pegwell Bay (61/346637). These localities were visited and samples of snails taken at 3-monthly intervals over a period of 2 years. The height

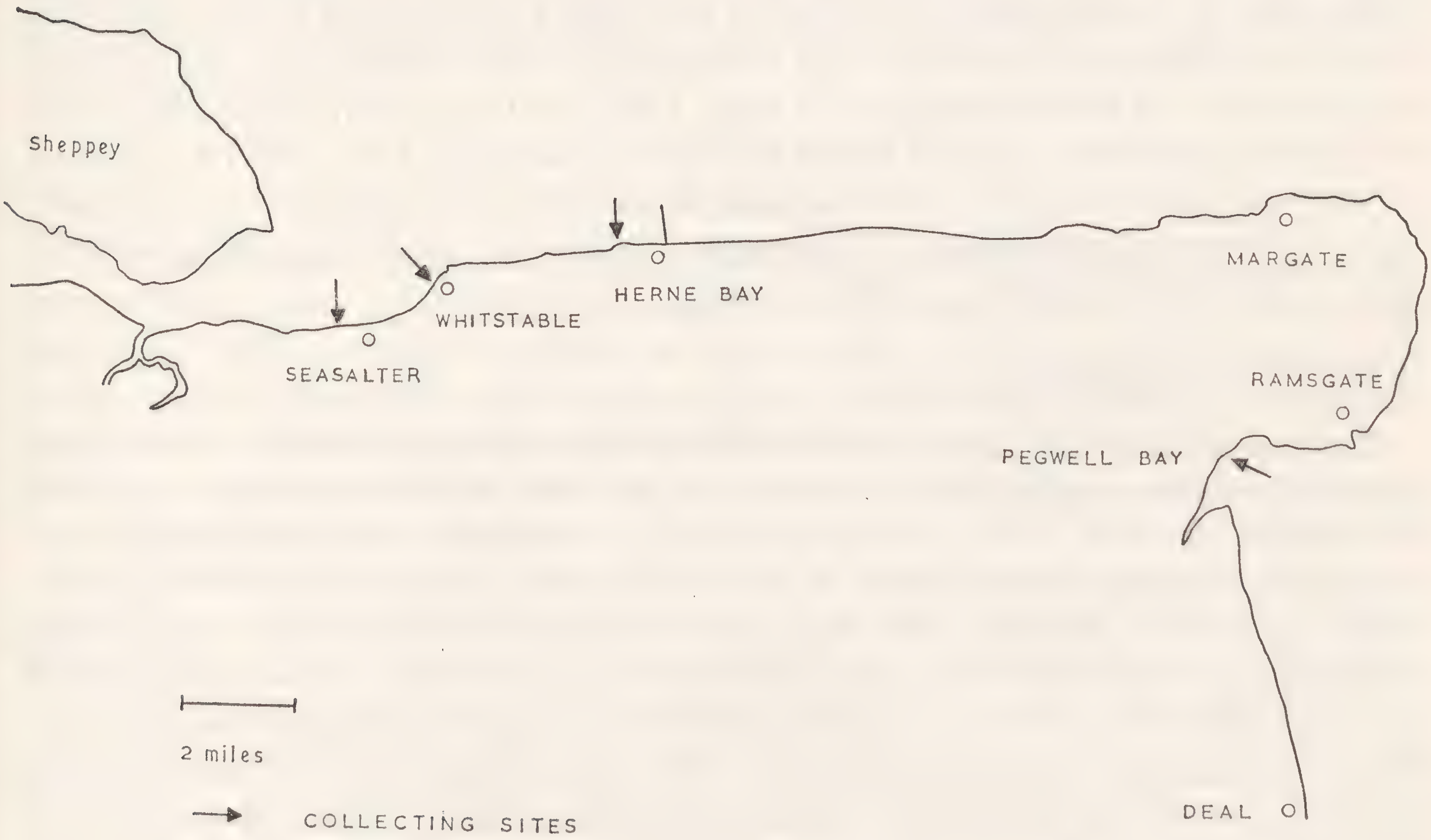

Fig. 1. Map of N.E. Kent to show the location of collecting sites for *Hydrobia ulvae*.

of the shells of living specimens were measured using a calibrated micrometer eye-piece in a binocular microscope and the results were used to demonstrate growth and life history.

OBSERVATIONS IN THE FIELD

1. *Habitat*

The habitats investigated in this survey are divided into 2 categories: (1) sand or mud flats almost devoid of a macroflora; (2) salt-marshes with a well developed macroflora usually including *Salicornia europaea* agg., " *Spartina townsendii* H. & J. Groves", *Suaeda maritima* (L.) Dum., *Puccinellia martima* (Huds.) Parl. and *Halimione portulacoides* (L.) Aell.

Seasalter, Whitstable and Herne Bay, Kent are examples of the first category. The shore at Whitstable (Newell, 1954) consisted of a loose shingle bank, a bound shingle zone with some marine algae including *Corallina officinalis* L., *Cladophora* spp. and *Chondrus crispus* Lyngb., and on the lower part of the shore a wide expanse of sandy flats. *Hydrobia ulvae* was common at Whitstable on both the bound shingle and the upper zone of sand flats, although since late 1967 its numbers appear to have decreased.

The shore at Pegwell Bay consisted of an extensive *Spartina–Salicornia* salt-marsh with muddy pools and some *Cladophora* spp. Below the salt-marsh was a wide expanse of muddy sand and at the fringe of the marsh was a zone of islands of *Spartina townsendii* colonizing new areas of sand (Ranwell, 1964). *Hydrobia ulvae* was abundant throughout the salt-marsh, reaching its greatest density on the lower marsh, but also, at low tide, extending on to the sand flats beyond the clumps of *Spartina*. The substratum on the lower marsh varied from time to time: on some occasions (25 Sept. 1966, 18 Dec. 1966) it included much sand and coarse shell material whilst on other occasions (1 Oct. 1967) it consisted of very fine mud with some black organic debris. Since the completion of the field work at Pegwell Bay, the part of the marsh used in this paper has been destroyed in the construction of a Hovercraft terminal.

2. *Behaviour of* Hydrobia ulvae

The activities of *H. ulvae* in the field during different months of the year essentially confirm previous observations on the tidal behaviour of this species at Whitstable (Newell, 1962). On the incoming or outgoing tide many snails were to be seen floating on the surface of the water, whilst some were crawling on the sand. At low tide however, few snails were seen active, even in pools, for at low tide they were buried in the sand. This floating behaviour, originally described for the Whitstable population, is basically true in the contrasting environment at Pegwell Bay and is also described for the population on the Ythan Estuary, Scotland (Anderson, 1971). The salt-marsh at Pegwell Bay included muddy areas of *Spartina* and *Salicornia* which were left dry at low tide, and snails in this microhabitat usually remained dry on the surface of the stiff mud or attached to plants. This hard mud was probably difficult for the snails to penetrate. Similar observations on a salt-marsh at Hayling Island, Hampshire, during October 1963 showed *Hydrobia ulvae* abundant and attached to stems of *Salicornia* at low tide. Muddy pools at Pegwell Bay retained water throughout the tidal cycle and whilst snails were frequently seen crawling on the bottom mud, floating appeared to be restricted to periods prior to and following high water.

Breeding

Hydrobia ulvae usually breeds during the summer months. Specimens sent from Wrabness, Essex mated in captivity in late March 1967. During April 1967, whilst collecting on the receding tide at Pegwell Bay, large numbers of *H. ulvae* were seen floating on the surface of the water in pairs and on examination the penis could be seen thrust into the genital opening of the female. Field observations therefore indicate that mating occurs in spring, although dates quoted for 1967 may be rather earlier than usual as a result of a mild winter. Laboratory observations showed that mating was to some extent a process of trial and error with some attempted copulation between males.

The earliest spawn was observed during the end of April 1967 and spawning was recorded as late as September. The spawn or egg-mass is laid and usually attached to the shell of another *H. ulvae* (Fretter and Graham, 1962). Veliger larvae hatch from the spawn in 16 days (in the laboratory) and the larva has a velum which lasts for 3 days. Unlike the velum of typical planktonic veligers it is not very effective in movement and appears to play no part in feeding and thus the young snail is able to crawl on the bottom substratum at a very early stage. Further information and illustrations of veliger larvae of *H. ulvae* are given in Pilkington (1971).

LIFE HISTORY

The histograms in Figs 2–4 are the results from the 3-monthly samples taken on the Kent coast at Whitstable, Seasalter and Pegwell Bay. From the gross samples of mud and snails collected at each station, a sub-sample of usually 100 snails was taken and the shell height measured: these included young specimens which could not be seen with the naked eye in the field. The solid line at 3 mm. and the dotted line at 4mm. in Figs. 2–4 have been included to facilitate comparison between the populations.

From these results, the highest proportion of young snails up to 1 mm. shell height was recorded at Pegwell Bay during April 1966 and July 1967 (the latter were probably the result of mating observed during April 1967); during July 1966 and 1967 at Seasalter and January 1966 and October 1967 at Whitstable. The growth of these young snails can be followed (Figs. 2–4) and it is deduced that *H. ulvae* at Whitstable and Seasalter take about 1 year to reach adult size and longer than this at Pegwell Bay, although it is possible that some Pegwell Bay snails may be able to breed when they are a year old.

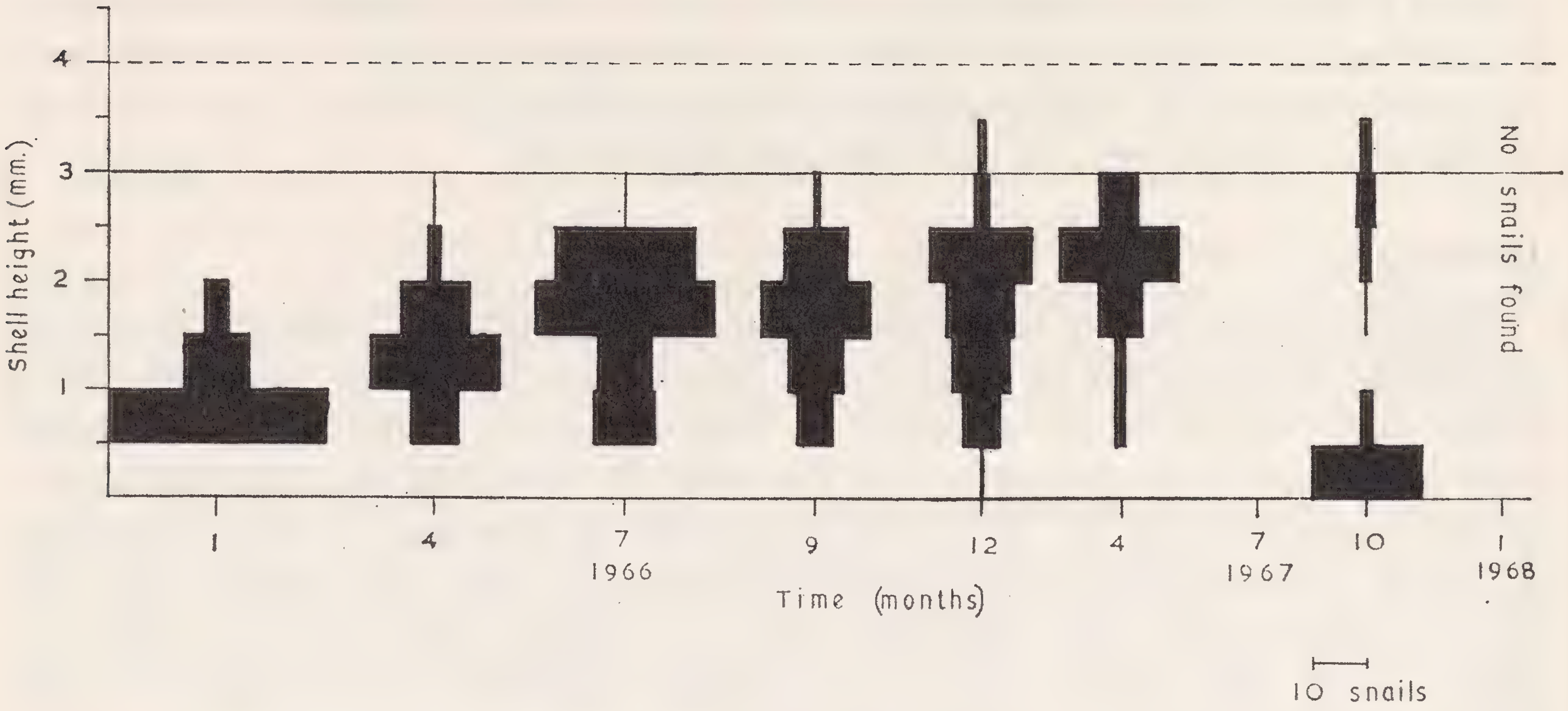

Fig. 2. Histograms to show frequency of *Hydrobia ulvae* of different size groups collected from sandy flats at Whitstable, Kent, 1966–1968. The width of the black band indicates the number of snails in the sample from each size group according to the scale inserted.

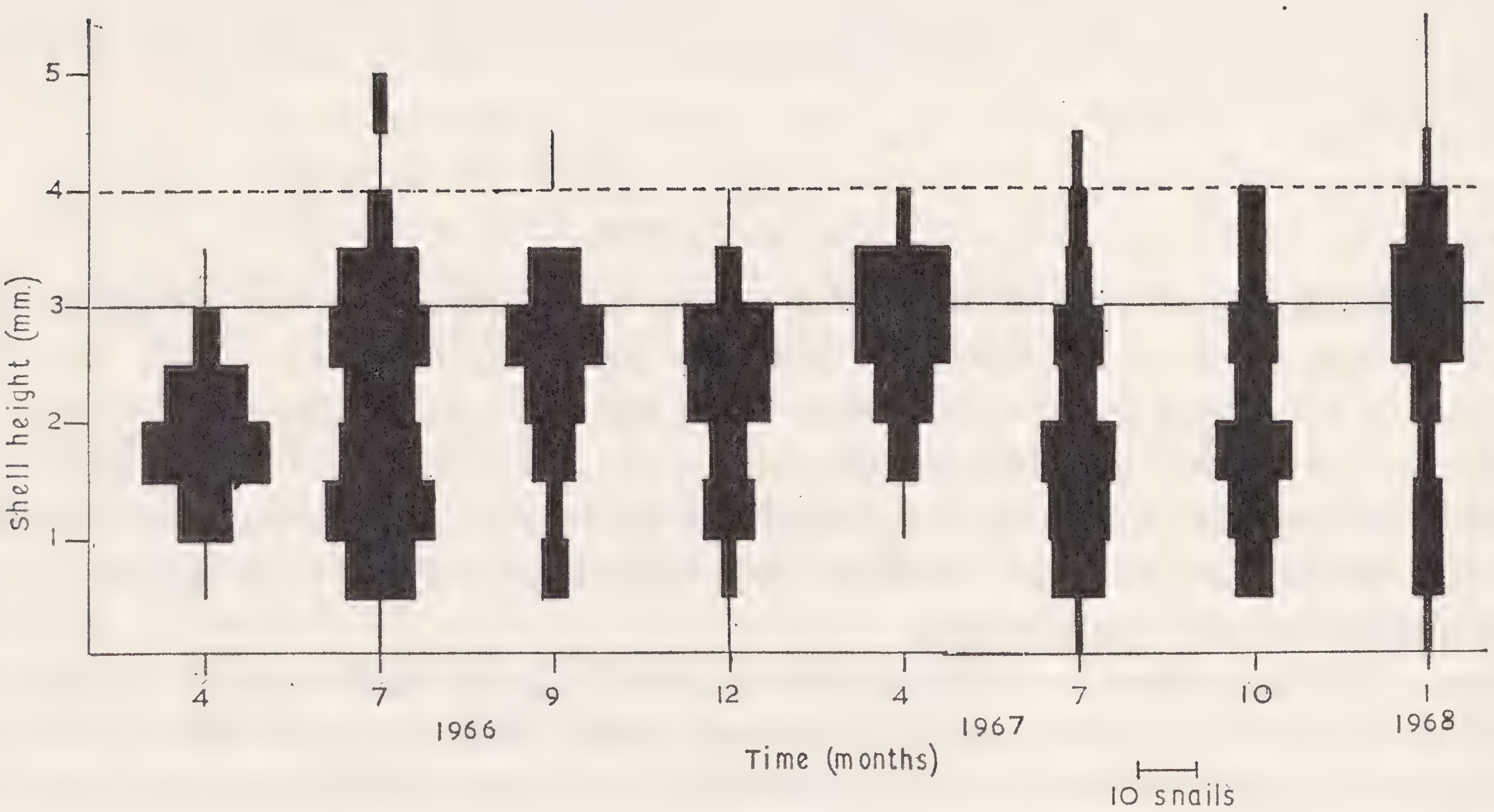

Fig. 3. Histograms to show frequency of *Hydrobia ulvae* of different size groups collected from muddy flats at Seasalter, Kent, 1966–1968.

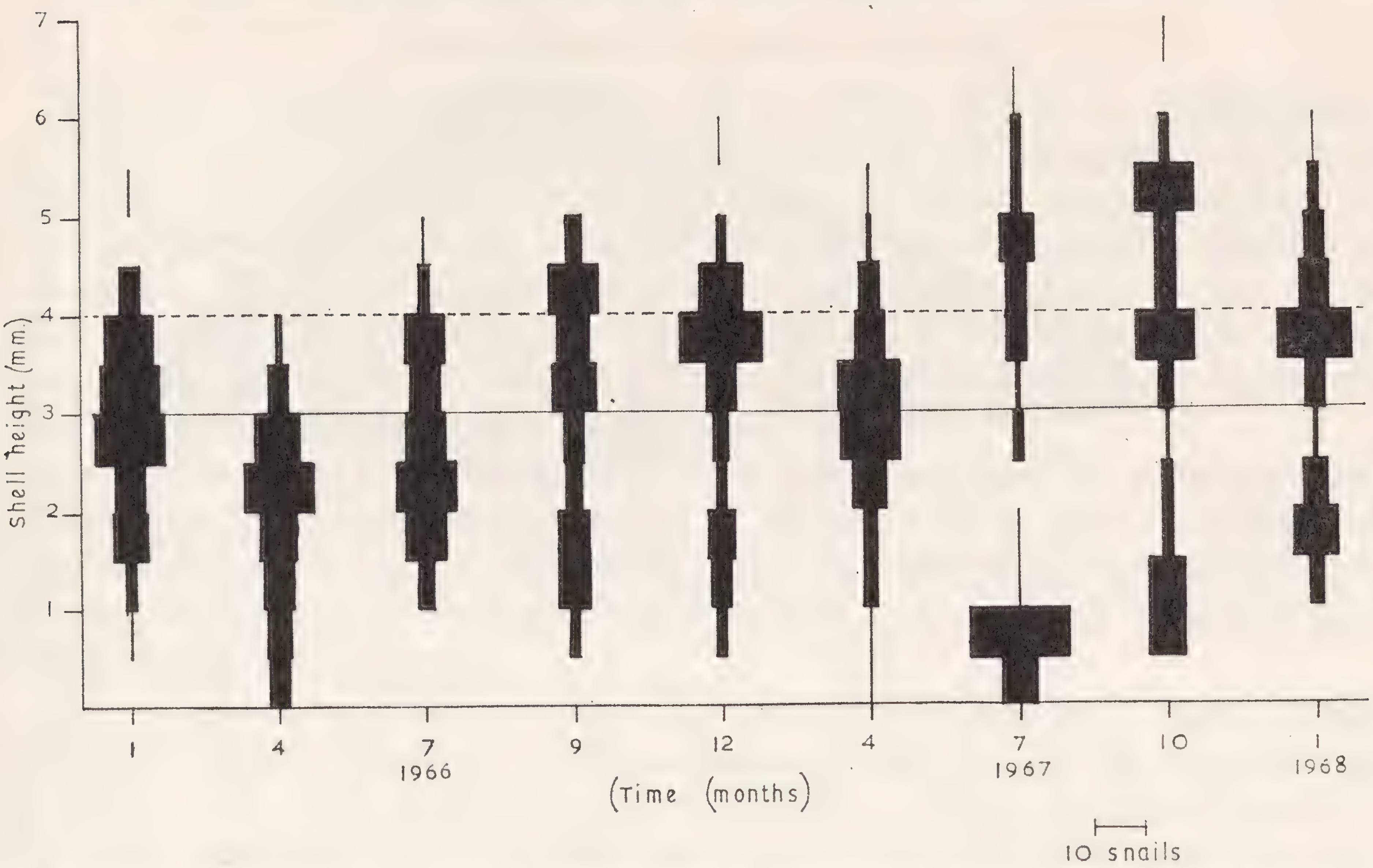

Fig. 4. Histograms to show frequency of *Hydrobia ulvae* of different size groups collected from a *Spartina* salt-marsh at Pegwell Bay, Kent, 1966–1968.

The snails feed and are able to grow during most months of the year, and although growth is probably minimal during the cold months of January and February, there is evidence that the growth rate accelerates with the onset of warmer weather in March and April: this is shown by new growth at the shell lip. Little growth was visible in the autumn (September–December) of snails from Seasalter and Pegwell Bay and in addition the age structure of the population showed little change suggesting few recruits and few deaths during autumn.

It is difficult to see evidence of infant mortality from the histograms although it is probable that some does occur. However the small numbers of eggs in the spawn (4–25, Fretter and Graham, 1962) together with the high population densities attained by *H. ulvae* suggests that wastage may be relatively small. It is possible to follow adult mortality on the diagrams. The highest numbers of adult snails were recorded during July 1966 and late April 1967 at Seasalter (over 3 mm.) and July 1966, December 1966 and April 1967 at Whitstable (over 2 mm.) and it appears that numbers of adult snails dwindle after breeding. At Pegwell Bay during the period of investigation there was little evidence of any large adult mortality as occurs in land snails (Chatfield, 1968) and evidence suggests that many of the April 1966 recruits were still alive in October 1967 having reached a size of 5–5·5 mm. shell height. Some of these probably died in January 1968 after living for nearly 2 years. In contrast *H. ulvae* at Whitstable appears to live for 1 year 3 months whilst those at Seasalter on muddy sand live for 1 year 6 months.

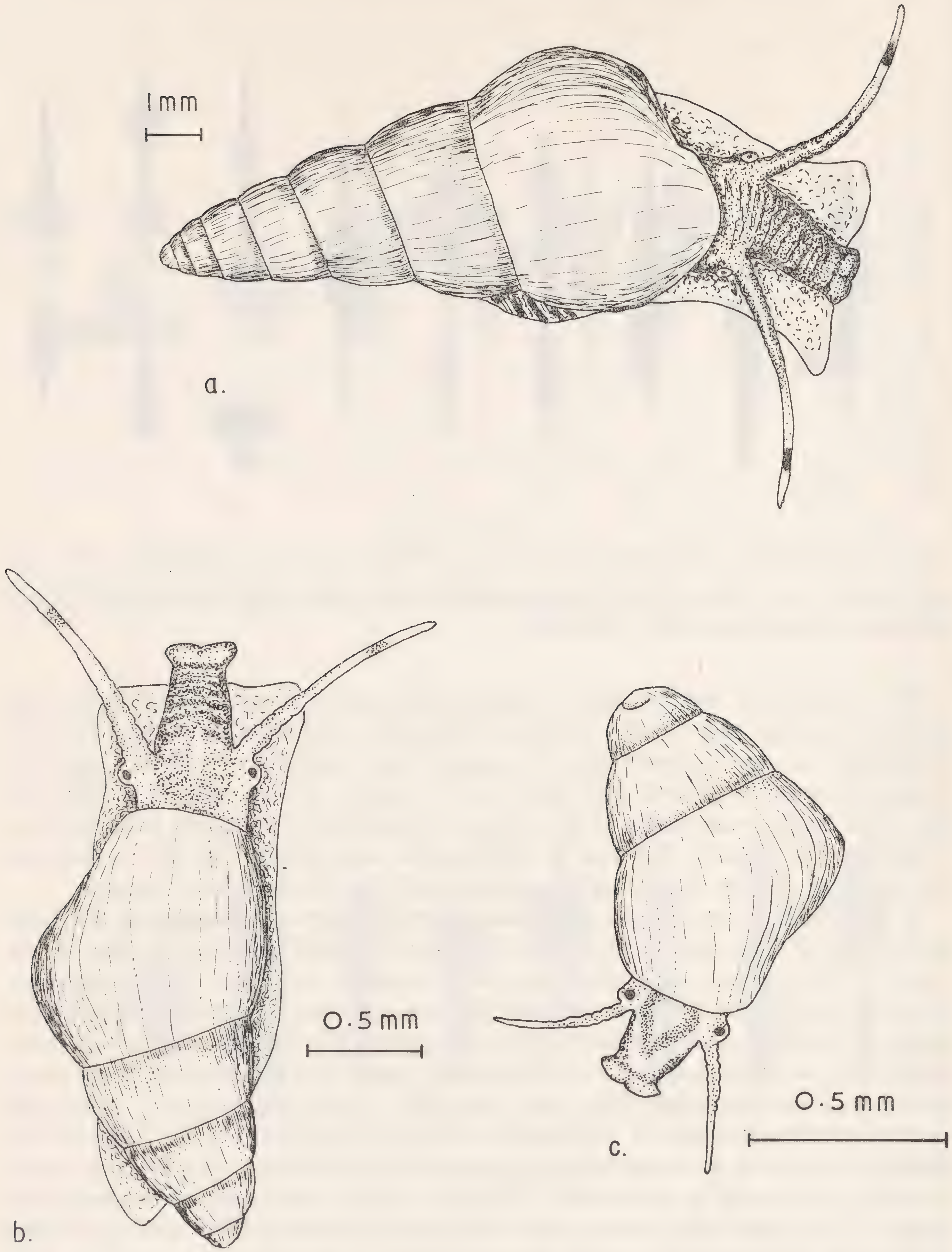

Fig. 5. *Hydrobia ulvae* showing the distribution of pigment on the head and tentacles (a) Large snail from channel of Lagoon 7, Shingle Street, Suffolk, June 1966: this snail was infected with cercariae; (b) An almost mature snail from Whitstable, Kent, July 1966; (c) Young snail from Herne Bay, Kent, July 1966.

VARIATION IN HYDROBIA ULVAE

There are 4 species of Hydrobiidae in the British fauna, the morphological differences between these species are subtle and in addition the problems of systematics are increased by infraspecific variation. Species are recognised by a combination of characters including the shape of the shell aperture, tumidity of the whorls, patterns of pigmentation on the tentacles and dorsal surface of the head and snout, the structure of the penis and small differences of the radular teeth. Investigations on chromosomes (Butot and Kiauta, 1966) show apparently consistent differences between these species.

Shell characters were widely used by most early systematists but may be subject to variation, and occasional specimens of *H. ulvae* have been recorded with exceptionally tumid whorls (Rothschild, 1936). In most populations the shells of *H. ulvae* do approach the typical condition and thus shells are usually a good initial guide in identification.

The pattern of head pigmentation (Fretter and Graham, 1962; Muus, 1963), and especially the black spots on the tentacles are also used in the recognition of *H. ulvae*. The results of this study showed that the density and distribution of the black pigment can vary with the age of the snail and sometimes culminating in the complete pigmentation of the snout in large snails (Fig. 5a). Specimens of 6 mm. shell length may retain the characteristic unpigmented patches on the snout shown in the snails of this size collected from the salt-marsh at Shingle Street, Suffolk in January 1967. However samples collected from the mud flats at Seasalter and the salt-marsh at Pegwell Bay, Kent during April 1967 showed heavy pigmentation of the snout in many specimens. Although the Pegwell Bay snails showed a tendency for heavy pigmentation in larger specimens, the snout was uniformly pigmented in some of the young snails from that collection (Fig. 6). The characteristic black spots on the tentacles (Fig. 5a, b) were not invariably present in either young snails (Fig. 5c) where few pigment granules had been deposited or in some large snails including one of 5·9 mm. shell length from Pegwell Bay, April 1967 where there was black pigment throughout the length of the tentacles.

H. ulvae has separate sexes and each has a relatively simple reproductive system (Fretter and Graham, 1962). The large penis of the male which (except during copulation) is situated within the mantle cavity differs in appearance in the Hydrobiidae from species to species (Muus, 1963). The penes of the snails from various habitats investigated proved to be alike (Fig. 7), and this confirms the identification of the snails (from the small specimens of North Kent to the large ones of Shingle Street, Suffolk) as *H. ulvae*.

Although the sizes of the snails in a population do vary with season, Figs. 2–4 show that the maximum shell length attained at any given time was not the same for all of the populations of *H. ulvae* studied in Kent. During the period of observation the maximum shell length reached was 2·7 mm. at Herne Bay, 3·4 mm. at Whitstable, 5·2 mm. at Seasalter and 6·6 mm. at Pegwell Bay. Further

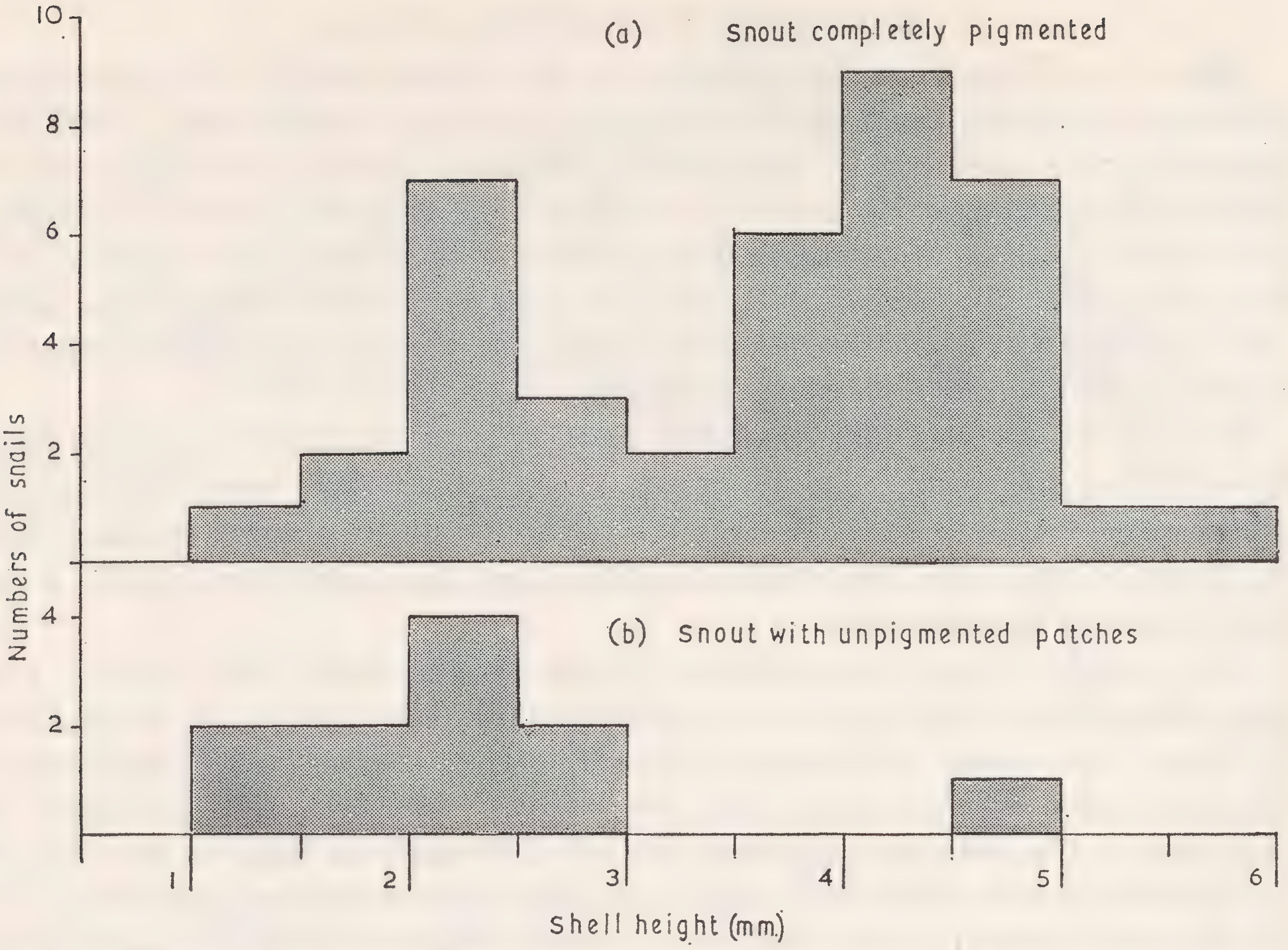

Fig. 6. Histogram to show the frequency of *Hydrobia ulvae* of various sizes (a) snout completely pigmented; (b) snout with unpigmented patches. Sample collected at Pegwell Bay, Kent, April 1967.

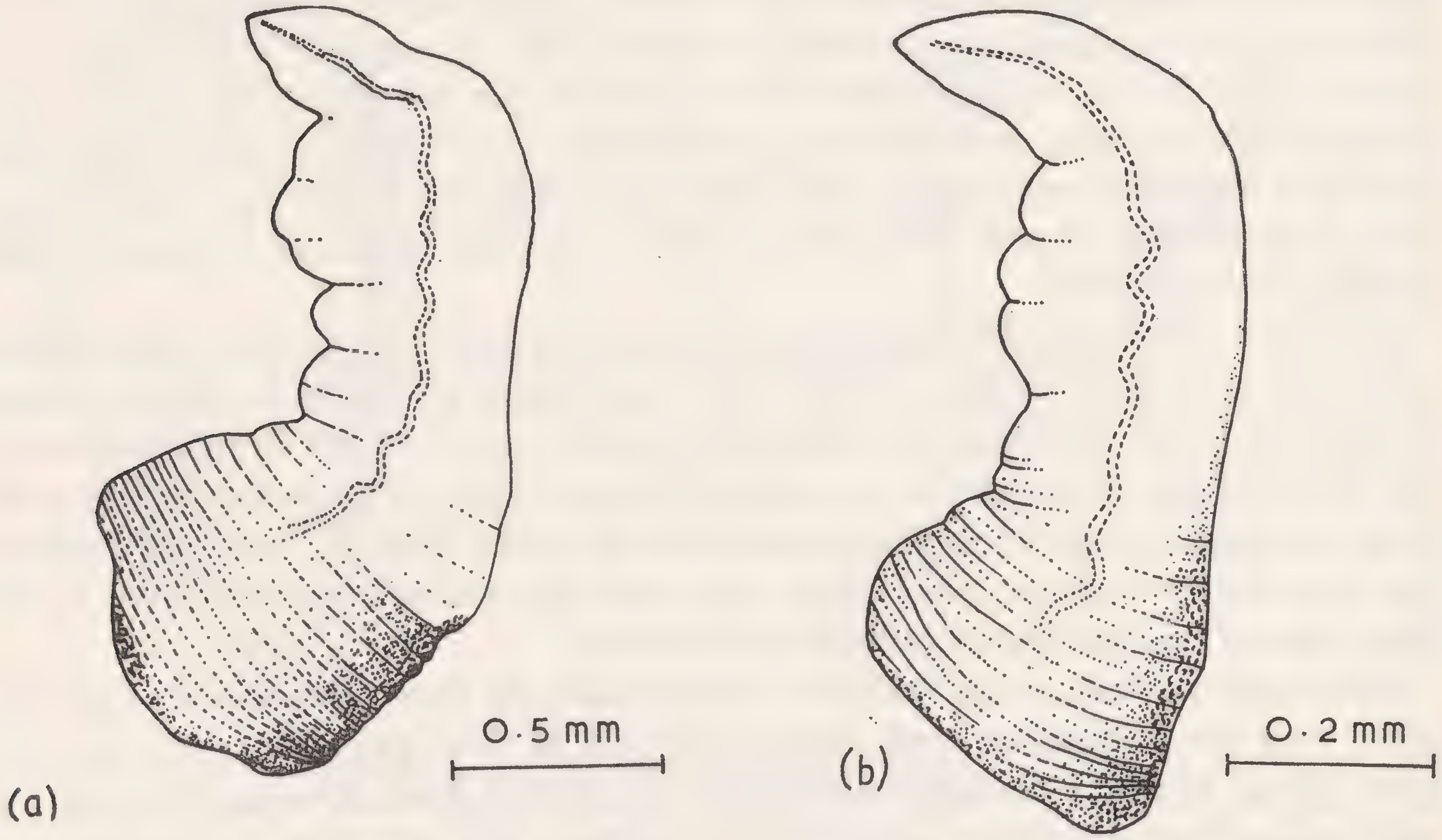

Fig. 7. *Hydrobia ulvae*: Penis of snail from (a) specimen of 6 mm. shell length from Shingle Street, Suffolk, March 1967; (b) specimen of 2.3 mm. shell length from Whitstable, Kent, dissected March 1967.

analysis of the results showed that *H. ulvae* at Whitstable rarely exceeded 3 mm.; at Seasalter snails up to 4 mm. were fairly common but only a few examples exceeded this whilst at Pegwell Bay half of the population exceeded 3 mm., examples up to 5·5 mm. were common and the occasional specimen was larger than this. Further work is in progress on size variation in *H. ulvae*.

DISCUSSION

This paper has outlined life cycles of *Hydrobia ulvae* from three contrasting sites in Kent and from these, it is apparent that the life-span and the height of the shell at maturity varies with the environment. These contrasting populations occurred along a 12-mile stretch of coastline (Fig. 1). As the snails passively float on the surface film of the water on the incoming and outgoing tides, there is some chance that samples of *H. ulvae* taken in the top centimetre of bottom mud may not be truly representative of the overall population on the shore. However certain consistent trends were evident in the data (namely the maximum size of the snails at maturity). Furthermore some pattern was apparent in the results plotted in the diagrams (Figs. 2–4).

The histograms for the equivalent month in sucessive years showed some variations that might reflect differences in weather conditions but the histograms show some progressive development from one sampling time to the next (3-monthly intervals). A more obvious pattern would probably have emerged had the sampling continued over a longer period of time. The progressive growth of certain peaks on the diagrams are feasible deductions as growth of *H. ulvae* in captivity varied from 0·1–0·7 mm. shell height per month. However in the field it is probable that growth varies with season with minimal growth during the colder months or after egg-laying. Thus little growth was evident between October and December (Figs. 2–4) or during the main egg-laying period in May. Further work on growth of *H. ulvae* is currently in progress. The appearance of numbers of young animals under 1 mm. shell height at the base of the histograms also showed some repetitive seasonal pattern although this appeared to be modified by weather.

Larvae of *H. ulvae* from Plymouth have a suppressed veliger phase (Pilkington, 1971) and a shell length of up to 0·4 mm. During the course of sampling young *H. ulvae* of shell length 0·3–0·4 mm. were found in substrata from all collecting sites and a few animals with shell length as small as 0·2 mm. were recorded from a coarse sand at Herne Bay. The more mature snails in the Herne Bay population were of small size.

The estimated life-span of *H. ulvae* of 1 year 3 months on sand at Whitstable, and of about 2 years on a salt-marsh at Pegwell Bay compare well with other British records of life-span. These include 1 year on mud and muddy sand on the north shore of the Dee Estuary, Cheshire (Stopford, 1951)—cf. Seasalter; 1 year 5 months in a pool in the muddy saltings of the River Tamar near Plymouth (Rothschild, 1941) and 2 years to maturity from mud-flats in the Ythan Estuary, Scotland (Anderson, 1971). This evidence suggests that the snails have a longer life-span on a muddy substratum, but as these records are from diverse localities in the British Isles it is also possible that climatic variation resulting from geographical location may affect the length of life. It is possible that growth may be slower in Scotland than in the more south-western localities and hence a longer time is necessary to attain maturity. Differences in life cycle in Scotland are recorded for the pond snail *Lymnaea stagnalis* (L.) (Berrie, 1965). In captivity *Hydrobia ulvae* may live for 5 years (Quick, 1924). Referring to life history of *H. ulvae* in Denmark (Ankel, 1962) gives the life-span in the range of 1½–2 years.

The main spawning season is from April to September as shown in this study and in the work of other authors. However Anderson (1971) has recorded some spawning in each month of the year. It is thus evident that although *H. ulvae* may be fairly opportunist in its breeding, the peak of spawning takes place in the summer.

The shell height of *H. ulvae* at maturity shows some variation between the habitats investigated in this study and also in the reports of other authors. The maximum size attained was 3·4 mm. on sand at Whitstable, 5·2 mm. on sandy-mud at Seasalter and 6·6 mm. on a muddy salt-marsh at Pegwell Bay. Similarly Rothschild (1938) and Howells (1964) noted differences in the maximum size of *H. ulvae* between populations on mud-flats and saltings. At Pegwell Bay, Seasalter and Whitstable *H. ulvae* was normally abundant on the surface of the mud or sand with the exception of Whitstable in 1967. Also the occurrence of *H. ulvae* at Herne Bay was inconsistent. Similar variations in occurrence have been reported by Stopford (1951) although she may have overlooked the youngest animals. In respect of samples taken in Kent for this survey, the sand or mud was carefully sifted in the laboratory for snails of all sizes.

SUMMARY

1. The life cycle of *Hydrobia ulvae* is described based on histograms of samples of snails from 3 contrasting sites along the Kent coast and also from observations in the field.

2. In the localities studied in Kent, *H. ulvae* breeds during late spring and summer and the snails take from 1–2 years to reach maturity. The life-span of snails from sandy flats at Whitstable was less than that of populations from a salt-marsh at Pegwell Bay.

3. *H. ulvae* from sand and sandy-mud flats attained a smaller shell length at maturity than specimens from salt-marshes.

4. There is considerable infra-specific variation in *H. ulvae*, both in shell characters and soft parts. Variation in head pigmentation is illustrated.

5. In the field *H. ulvae* was observed floating on the water film, crawling and burrowing in the mud and ascending vertical objects on the shore.

ACKNOWLEDGMENTS

I am grateful to Dr. R. C. Newell for my first specimens from Seasalter and to Miss Rachel Thomas for specimens from Wrabness, Essex. For laboratory facilities I thank Professor A. Graham, Zoology Department, University of Reading and for financial support Reading University Research Board. Mr. B. W. Barrett read and commented on the manuscript.

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J. Conch. **27**: 474 (1972)

REVIEW

Seashells of Australia by Walter Deas. London: Robert Hale and Company. Adelaide: Rigby Ltd. 1971. pp. 32, 74 col. pls., end-paper map. Price £1.50.

The very high quality of photography evident throughout this book and the careful selection of the material used have combined to create a volume which will please all who find beauty in shells and in the animals which create them. No less than one-third of the plates depict living molluscs, or shells in their natural habitats. Where the shells alone are portrayed the colours are remarkably accurate, and even in such difficult subjects as the cowries the reflection of light from the glossy surfaces has been reduced to a minimum. The inclusion of some very rare shells as well as many of the commoner species adds interests, but it is inevitable that in such a slim volume many species, both common and rare, will have had to be omitted, and the total number of species illustrated is fewer than 150.

Common and Latin names are given, though a few of the scientific names are slightly mis-spelt, examples being "lahaunus" for "luhuanus", "helvolva" for "helvola", "xanthadon" for "xanthodon" and "caputserrentis" for "caputserpentis". As well as the names there is also an indication of where the species occur in Australian waters, the size of the shells and occasionally notes on any special features, but it has not been thought necessary to compile an index. The end-paper map indicates specific localities (sometimes two or three) around the Australian coasts for many of the shells, but on such a map it is not possible to show the exact limits of distribution of any species, and one might assume falsely that the species was restricted to those localities. On the same map about half of the generic names commence with a small letter, but perhaps it is arguable that on an end-paper some artistic licence is permissible.

A short introduction emphasizes the part played by scuba divers of recent years, and photographs of them under water are included. The duplication on the actual cover of the book, with its matt surface, of the coloured photographs on the dust cover is very effective. From the point of view of the illustrations alone this attractive publication will be considered good value by many who add it to their bookshelves. The seeker after detailed information on the shells will need to supplement the few facts given by reference to other sources.

R. P. Scase

J. Conch. **27**: 475–489 (1972)

RELATIONSHIP OF SIZE TO AGE IN THE COCKLES *CERASTODERMA EDULE* AND *C. GLAUCUM* FROM THE RIVER CROUCH ESTUARY, ESSEX

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(*Read before the Society*, 15 *April* 1972)

INTRODUCTION

A mixed population of the cockles *Cerastoderma edule* (= *Cardium edule*) and *C. glaucum* Poiret (= *C. lamarcki* Reeve) is established in the estuary of the River Crouch, Essex.

An analysis of the habitats occupied by these cockles within the British Isles has concluded that *C. glaucum* is typically found in saline seepage pools or lagoons (Boyden, 1969), where aerial exposure and wave action is minimal, whilst in contrast *C. edule* demands a degree of water movement and renewal such as occurs sub-littorally or on tidal shores (Russell, 1971; Boyden and Russell, 1972). This latter cockle is a well adapted member of the intertidal fauna of particulate shores, displaying such adaptations as air-breathing during low tide conditions (Boyden, 1972).

Within the Crouch estuary the quite extensive mixed cockle population has enabled comparative studies between *C. edule* and *C. glaucum* to be conducted upon animals collected from a common environment. This paper forms part of a series (see also Boyden, 1971a, 1972) elucidating the relationship between these two cockles, and is also concerned with the relationship of size to age in the two cockles.

MATERIALS AND METHODS

Cockles were collected by hand from a limited area of fore-shore at low water in the Crouch estuary at Hullbridge "ferry" during May 1968. The two cockles were distinguished by diagnostic characteristics listed elsewhere (Boyden, 1971b). For further details see Høpner Petersen (1958) and Tebble (1966). The cockles were aged by examination of annual rings† and shell height measured. Shell

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† I am grateful to Mr. G. Pickett of Burnham Shellfish Laboratory for initial assistance in ageing of cockles.

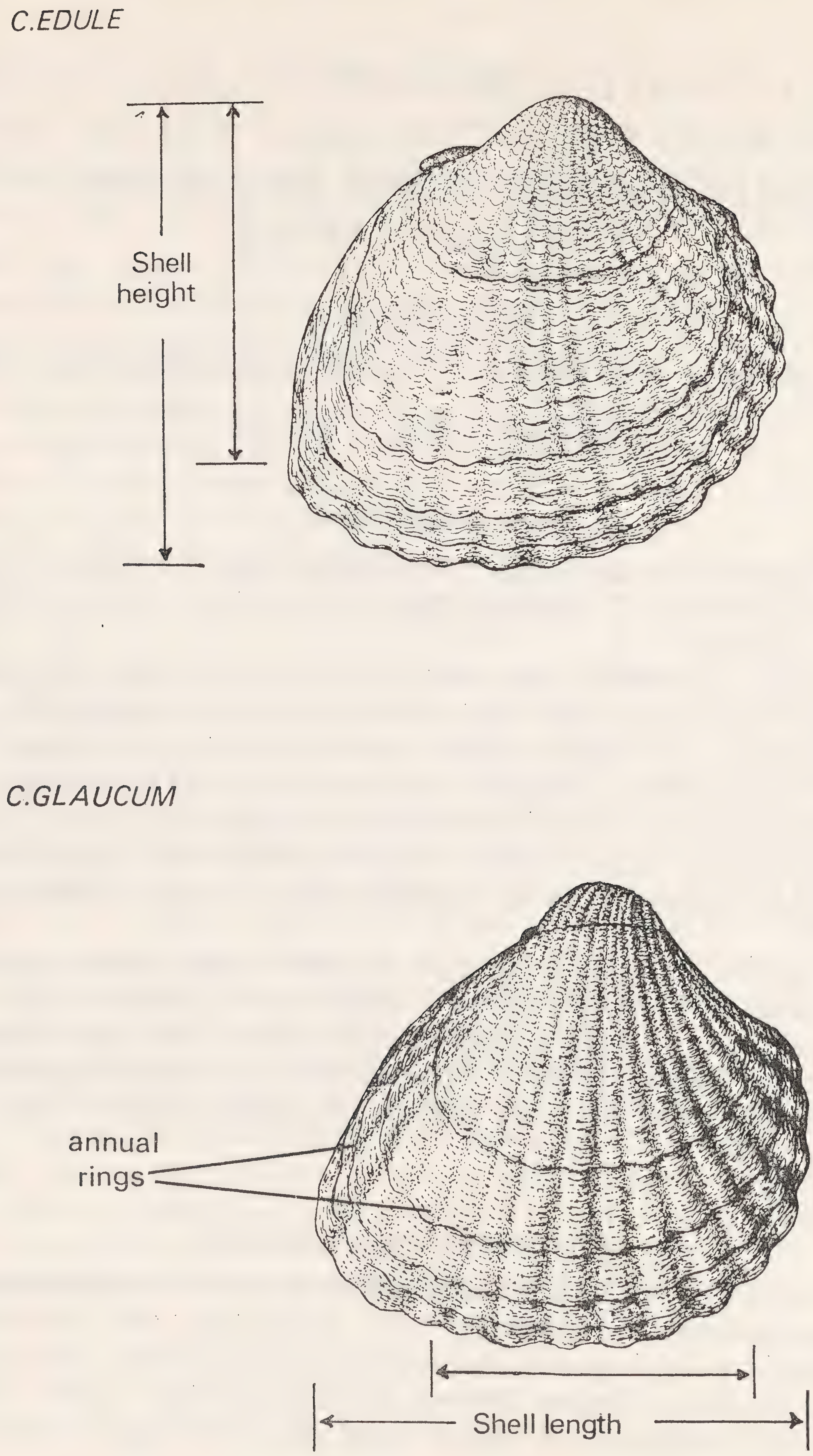

Diagram 1. Side view of the two species of *Cerastoderma* showing external shell characteristics.

parameters of length and height (measured along the "middle rib" perpendicular to the longitudinal axis of the shell) of all annual rings of individuals varying from one to seven years old were measured to the nearest 0·05 mm. using vernier callipers (see Diag. 1). Shell height was selected in this comparative study in contrast to shell length or breadth, since shell height bears the same relationship to tissue weight in the two cockle species (see Fig. 1). Studying individuals of the same age *C. glaucum* exhibits posterior elongation of the shell and tends to be broader than *C. edule*.

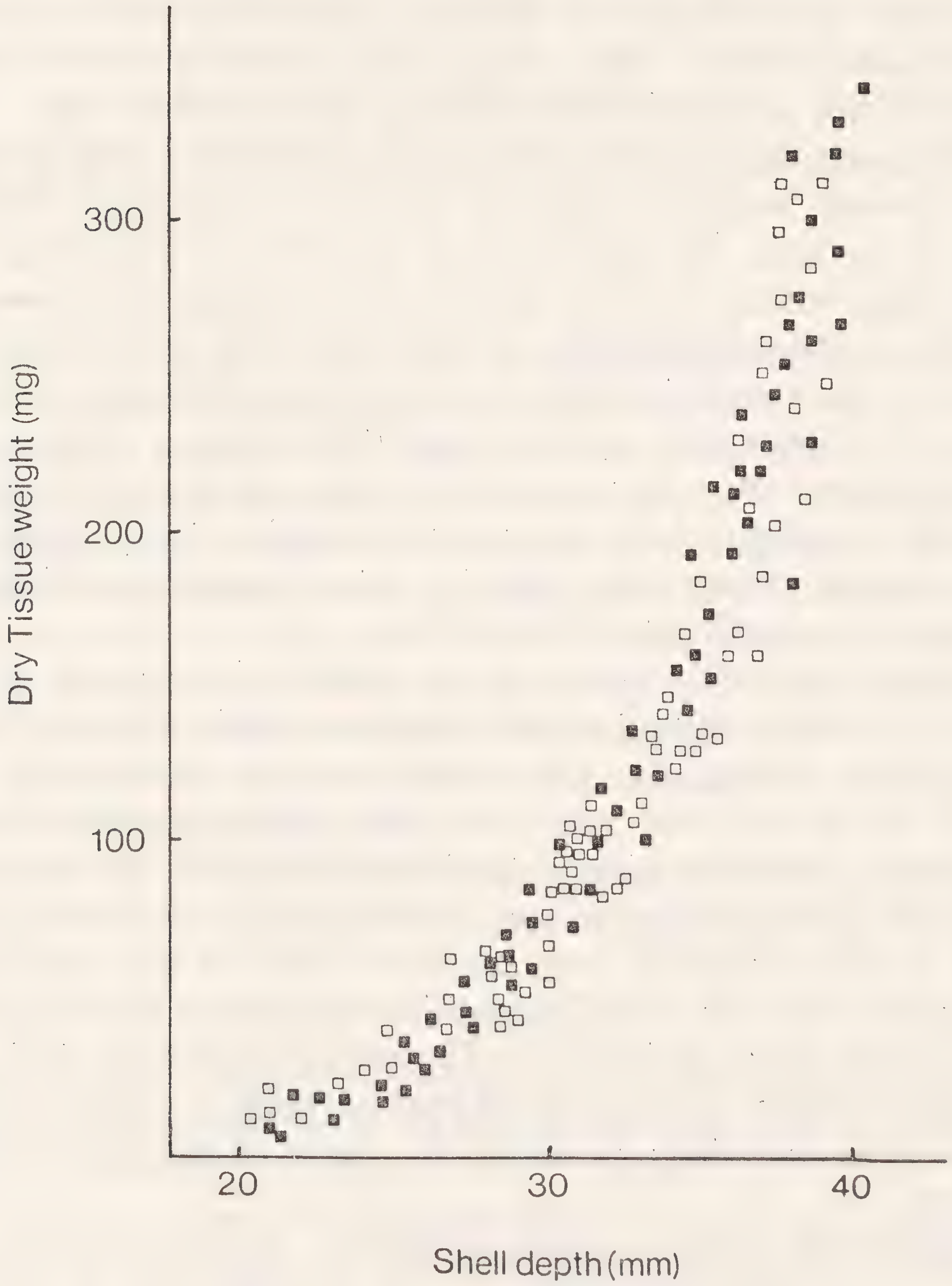

Fig. 1. Winter relationship of shell depth to dry tissue weight in the two *Cerastoderma* from the Crouch mixed cockle population.; ■ *C. edule*, ☐ *C. glaucum*.

RESULTS

Annual rings and age structure of the Crouch cockle populations

The use of annual shell rings as a means of establishing age has been employed in a variety of lamellibranchs: *C. edule* (L.), Walton (1919) and Orton (1926); *Tivela stultorum* Weymouth (1923); *Cardium corbis* Fraser (1932); *Venerupis pullastra* (Montagu), Quayle (1952); *Placopecten magellanicus*, Stevenson and Dickie (1954); *Scrobicularia plana* (da Costa), Green (1957) and Hughes (1970); *Pecten maximus* (L.) Mason (1957); *Macoma balthica* (L.), Segerstråle (1960); *Anodonta anatina* (L.) and *Unio balthica* (L.), Negus (1966); *Mytilus edulis* (L.), Seed (1969) and *Tellina tenuis* (da Costa), McIntyre (1970). During the winter months in these bivalves, the mantle edges are withdrawn from the shell margins, causing a cessation of shell growth. However, the innermost nacreous layer is continuously deposited (Seed, 1969). Thus, when growth is resumed, old and new regions of the shell are not continuous, resulting in an obvious ring.

Orton (1926) noted that the shell of *C. edule* exhibited a well marked series of rings which represent annual periods of growth cessation associated with the colder months of the year. He qualified this, however, by recording the presence of disturbance rings which could be produced by various environmental irregularities, e.g. gales, shifting substratum, or even caused by removal of cockles from their habitat for a short period. In the Crouch estuary disturbance, probably due to movement of sailing craft, produces such disturbance rings but these are generally less prominent than the true annual rings, and usually do not completely encircle the shell, tending to fade away at the margins (Cole, 1956). Thus upon the picture of annual winter-rings may be super-imposed additional rings, not related to the annual growth rate of the cockles.

In older cockles, the umbo region of the shell is often worn (a feature also observed in the Canadian littoral cockle *Cardium corbis*, Fraser, 1932), thus the first ring laid down during the first winter may be obliterated. Considering Crouch cockles the growth rate and consequent shell deposition is large during the second summer, assuming normal food availability. In the first summer, the growth rate is also correspondingly large, but the period of growth and probably available food is less, as spatfall does not occur until at least mid-June. By the third growing season the rate of shell deposition has slowed, and is proportionately reduced as the cockle ages (see Diag. 1). The period of greatest shell deposition is thus in the second summer of life. Crouch cockles, both *C. edule* and *C. glaucum*, exhibit prominent annual rings, probably the result of relatively cold winters in eastern England.

The age distributions of 550 *C. edule* and 672 *C. glaucum* are shown in Figure 1. Within the estuary spatfall density varies considerably, in the population sampled young year classes were comparatively rare. Five year old individuals were most common and there was clearly a distinct scarcity in numbers of older year classes. This feature corresponds with the exceptionally cold winter of 1962/3 when a high mortality of cockles in south-east England was recorded (Crisp,

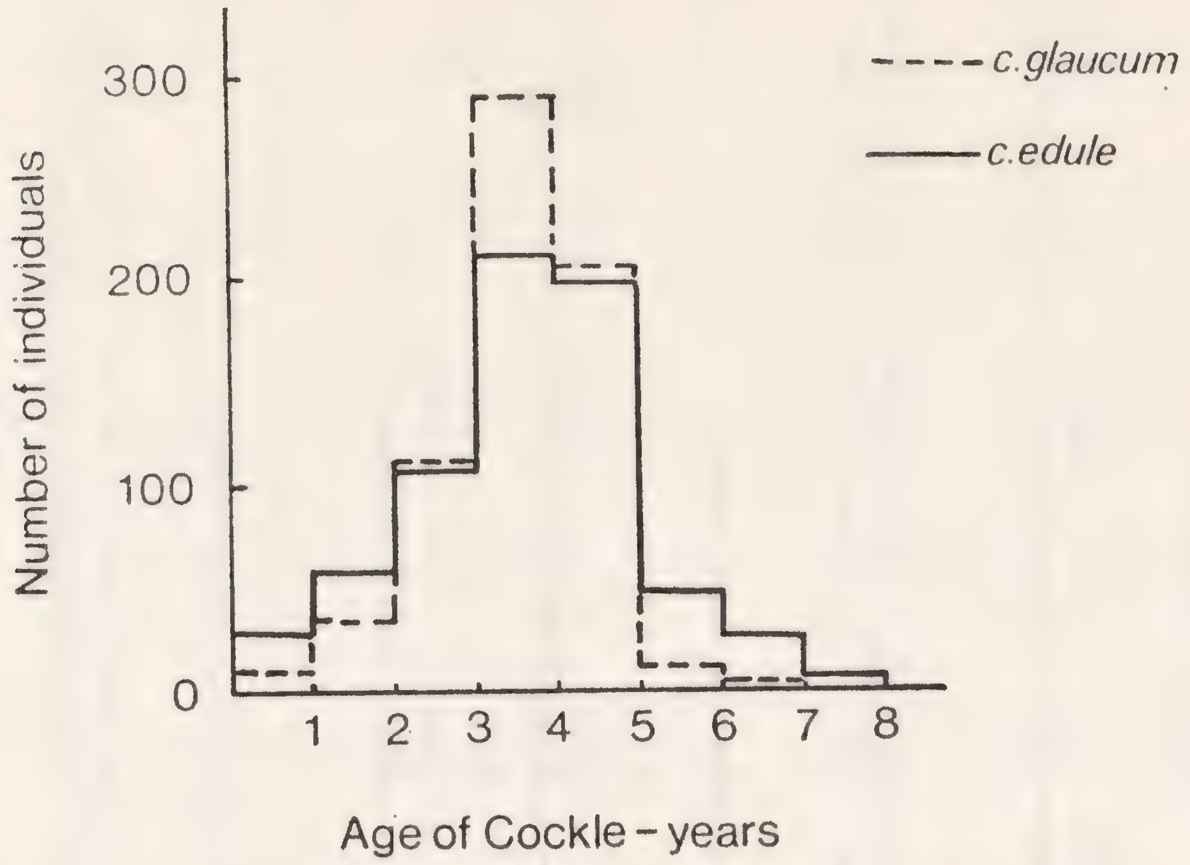

Fig. 2. Age structure of the Crouch populations of *C. edule* and *C. glaucum* in 1968; —— = *C. edule*, - - - - = *C. glaucum*.

1964). Abundance of 4 and 5 year old individuals indicates the successful settlement of 1963 and 1964 spat within the upper reaches of the Crouch. Studying the cockle resources of the Wash area Franklin and Pickett (1968) found that there had been little recruitment of the stocks since the outstanding spat-fall of 1963. Thamdrup (1935) concluded that the severe winter of 1928/9 exterminated a large proportion of the *C. edule* population in the German Wadden Sea at Skallingen, but noted that this was followed in the next two years by extensive settlement and that these cockles had then dominated the population for the next few years. Smidt (1944) summarised the effects of this cold winter, and suggested that there was an inverse relationship between the numbers of established cockles and numbers of settling individuals.

Thus it appears that fluctuations in cockle population density are cyclical, and a similar pattern may be reproduced on widely separated beds.

Comparison in size of C. edule *and* C. glaucum

The relationship of total shell height to age, absolute growth, is shown in Figure 3. In general, considering cockles of the same age (i.e. same number of annual rings) *C. glaucum* are smaller than *C. edule.*

Tables 1 and 2 summarise the measurements of length and height of all annual rings visible upon the shells of Crouch cockles measured in May 1968. The difference in size between the two cockles remains fairly constant irrespective of age. For the 6 ages measured (1–7 ring individuals) the difference in mean shell height between the cockles was 6·0, 6·5, 4·8, 4·0, 4·1 and 4·7 mm. respectively. There is an initial difference in size of the first year cockles and this is maintained over the subsequent years. This feature has been correlated with the fact that

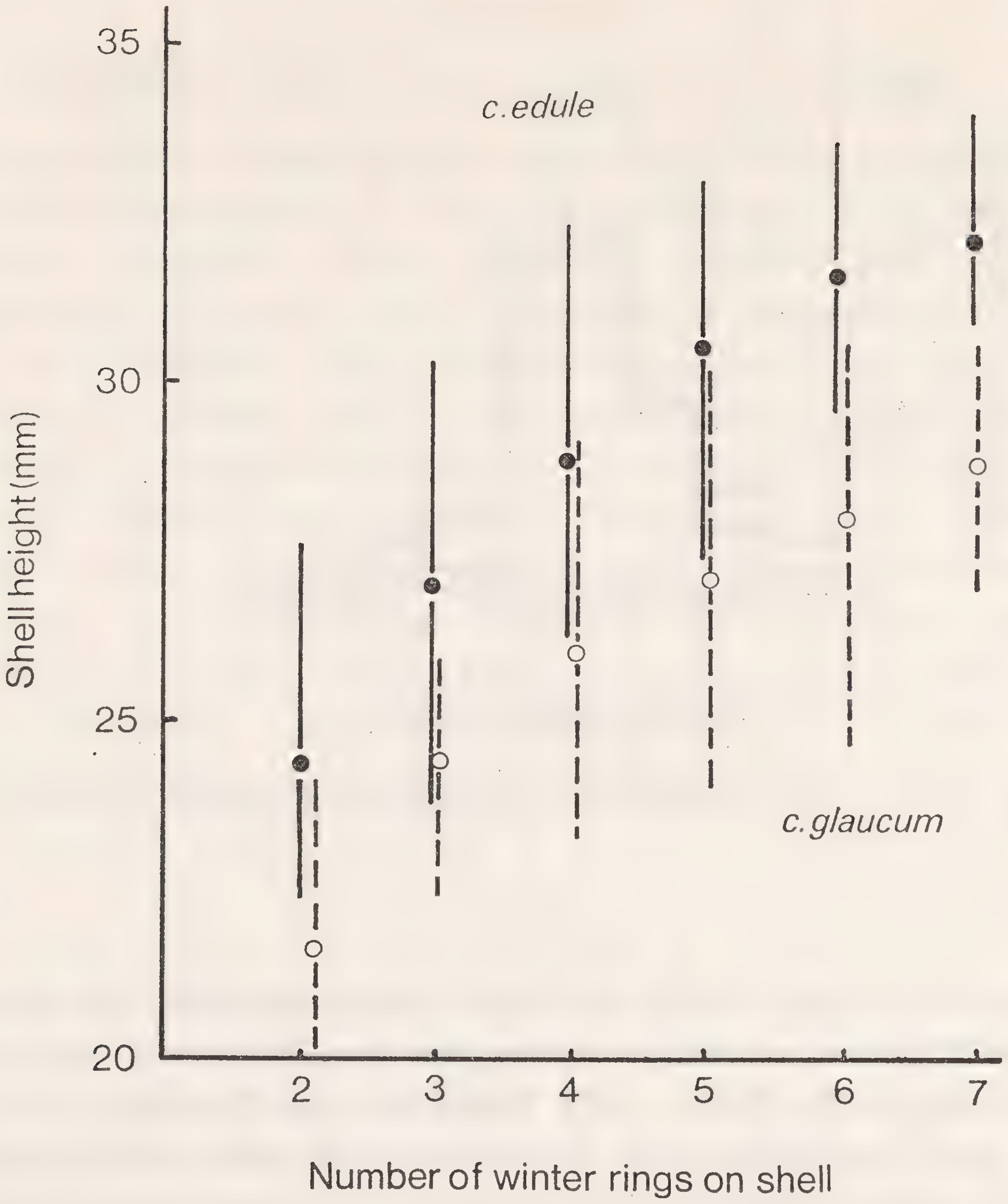

Fig. 3. Relationship of shell height (mm) to age in the two *Cerastoderma* from the Crouch mixed cockle population; ——●—— mean shell height and range in size of *C. edule*, – – –○– – – mean and range of values of *C. glaucum.*

C. edule in the Crouch estuary spawns on average 7 to 8 weeks prior to *C. glaucum* (Boyden, 1971a). Assuming similar lengths of larval planktonic life in the two cockles (larvae of *C. edule* are planktonic for 2–5 weeks, Lebour, 1938; Creek, 1960) settlement is likely to occur earlier in *C. edule.* The growing season of juvenile cockles extends to the end of October (i.e. until temperatures fall below c. 12°C. and inhibit growth), *C. edule* grows for approximately 18 weeks in the first summer subsequent to settlement compared with 11 weeks in *C. glaucum. C. edule* larvae released into the water column early in the year would also be able to take advantage of any spring bloom of phytoplankton and thus may exhibit fast growth. Estimating from above, the length of growing season in *C. glaucum* is approximately 61·1% that of *C. edule.* From Table 2 the average shell depth of first year cockles is 15·4 and 9·4 mm. for *C. edule* and *C. glaucum* respectively; *C. glaucum* is in the region of 60% the size of *C. edule.* Thus there is clear positive correlation in cockle size to estimated length of growing season of 0-year individuals assuming differential spawning of *C. edule* and *C. glaucum.*

TABLE 1

Average shell lengths (mm) and growth increments (mm) of the two *Cerastoderma* collected from the Crouch mixed cockle population

A) *Cerastoderma edule*

		SIZE OF ANNUAL RINGS												
GROWING YEAR FIRST SUMMER'S GROWTH	NUMBERS EXAMINED	SIZE 1ST RING	GROWTH —MM'S	SIZE 2ND RING	GROWTH —MM'S	SIZE 3RD RING	GROWTH —MM'S	SIZE 4TH RING	GROWTH —MM'S	SIZE 5TH RING	GROWTH —MM'S	SIZE 6TH RING	GROWTH —MM'S	SIZE 7TH RING
1967	10	18·2	—	—	—	—	—	—	—	—	—	—	—	—
1966	10	18·8	8·2	27·0	—	—	—	—	—	—	—	—	—	—
1965	15	19·5	8·6	28·1	3·4	31·5	—	—	—	—	—	—	—	—
1964	19	17·4	10·7	28·1	3·8	31·9	1·3	33·2	—	—	—	—	—	—
1963	18	14·7	14·1	28·8	4·3	33·1	1·8	34·9	1·1	36·1	—	—	—	—
1962	10	16·5	10·7	27·2	4·5	31·7	2·7	34·4	1·2	35·6	1·2	36·8	—	—
1961	10	12·7	13·0	25·7	4·4	30·1	3·2	33·3	2·3	35·6	1·0	36·6	0·8	37·4
Mean values:—		16·8	10·9	27·5	4·1	31·7	2·2	33·9	1·5	35·8	1·1	36·7	0·8	37·4

B) *Cerasteroderma glaucum*

		SIZE OF ANNUAL RINGS												
GROWING YEAR FIRST SUMMER'S GROWTH	NUMBERS EXAMINED	SIZE 1ST RING	GROWTH —MM'S	SIZE 2ND RING	GROWTH —MM'S	SIZE 3RD RING	GROWTH —MM'S	SIZE 4TH RING	GROWTH —MM'S	SIZE 5TH RING	GROWTH —MM'S	SIZE 6TH RING	GROWTH —MM'S	SIZE 7TH RING
1967	10	11·2	—	—	—	—	—	—	—	—	—	—	—	—
1966	10	12·7	8·1	20·8	—	—	—	—	—	—	—	—	—	—
1965	21	12·4	8·0	21·4	4·3	25·6	—	—	—	—	—	—	—	—
1964	20	11·9	9·5	21·5	4·7	26·2	2·1	28·3	—	—	—	—	—	—
1963	15	8·9	11·5	20·4	4·1	24·5	2·1	26·6	1·6	28·2	—	—	—	—
1962	10	9·0	8·7	17·7	6·6	24·6	3·4	28·0	1·5	29·8	1·2	31·0	—	—
Mean values:—		11·0	9·6	20·3	4·9	25·2	2·5	27·6	1·5	29·0	1·2	31·0	—	—

TABLE 2

Average shell depths (mm) and growth increments (mm) of the two *Cerastoderma* collected from the Crouch mixed cockle population

A) *Cerastoderma edule*

Growing year First summer's growth	Numbers examined	Size 1st ring	Growth —mm's	Size 2nd ring	Growth —mm's	Size 3rd ring	Growth —mm's	Size 4th ring	Growth —mm's	Size 5th ring	Growth —mm's	Size 6th ring	Growth —mm's	Size 7th ring
		Size of annual rings												
1967	10	16·7	—	—	—	—	—	—	—	—	—	—	—	—
1966	10	17·3	8·3	25·6	—	—	—	—	—	—	—	—	—	—
1965	15	16·1	8·5	24·6	2·3	26·9	—	—	—	—	—	—	—	—
1964	19	16·5	9·4	25·9	2·7	28·6	1·3	29·9	—	—	—	—	—	—
1963	15	13·8	12·3	26·1	3·4	29·5	1·6	31·1	0·9	32·0	—	—	—	—
1962	10	15·6	9·2	24·8	4·0	28·8	1·6	30·4	1·2	31·6	0·9	32·5	—	—
1961	10	11·9	11·8	23·8	3·4	27·2	2·6	29·8	1·7	31·5	1·2	32·7	0·7	33·4
Mean values:—		15·4	9·9	25·1	3·2	28·2	1·8	30·1	1·3	31·7	1·1	32·6	0·7	33·4

B) *Cerastoderma glaucum*

Growing year First summer's growth	Numbers examined	Size 1st ring	Growth —mm's	Size 2nd ring	Growth —mm's	Size 3rd ring	Growth —mm's	Size 4th ring	Growth —mm's	Size 5th ring	Growth —mm's	Size 6th ring	Growth —mm's	Size 7th ring
		Size of annual rings												
1967	10	9·4	—	—	—	—	—	—	—	—	—	—	—	—
1966	23	10·7	8·9	19·6	—	—	—	—	—	—	—	—	—	—
1965	46	10·3	8·8	19·1	3·5	22·6	—	—	—	—	—	—	—	—
1964	20	11·1	8·1	19·9	4·2	24·1	1·7	25·8	—	—	—	—	—	—
1963	14	8·4	12·1	20·5	3·8	24·3	2·3	26·6	1·4	28·0	—	—	—	—
1962	10	6·7	7·3	14·0	8·6	22·6	3·2	25·8	1·4	27·2	0·7	27·9	—	—
Mean values:—		9·4	9·0	18·6	5·0	23·4	2·4	26·1	1·4	27·6	0·7	27·9	—	—

TABLE 3

Variation in length (mm) of *C. edule* of different ages from various localities

LOCATION OF POPULATION	AGE OF COCKLE 0—1 YEAR GROUP 1-RING	 1—2 YEAR GROUP 2-RINGS	 2—3 YEAR GROUP 3-RINGS	 3—4 YEAR GROUP 4-RINGS	 4—5 YEAR GROUP 5-RINGS	AUTHORITY
River Yealm, Plymouth	19—22 (max. 27/28)	28—31 (max. 35)	36—37 (max. 43)	35—39 (max. 41)	41—45 (max. 45/46)	Orton (1926)
Swansea Bay, S. Wales	17.4	24.0	—	—	—	Wright (1926)
Maplin Sands, Essex	11·1	—	22·0	28·0	—	
Lancashire coast (permanently submerged)	13—15 (mode 18.5)	21—34 (mode 27·5)	21—38 (mode 31·5)	29—40 (mode 35·1)	— —	McCloy et al (1937)
Dutch Wadden Sea	19—22 (max. 24/28)	28—32 (max. 35/37)	33—36 (max. 38/43)	35—39 (max. 41/45)	— —	Kreger (1940)
Dutch Wadden Sea						
—littoral flat	19·5	28·1	32·0	—	—	Kristensen (1956)
—living in creek	14·0	20·6	25·6	—	—	
Range from a selection of sites around British coasts	9·3—15·9	17·9—28·5	23·1—32·7	31·1—39·9	31·6—41·7	Cole (1956)
Llanrhidian sands, Wales	12·6—13·4	21·1—24·0	26·0—26·9	28·2—29·2	29·7—29·8	Hancock (1965)
Summary of size ranges in literature above:	9·3—22	19·9—31	21—38	28·2—40	29·7—45	
Average sizes of Crouch *C. edule*	16·8	27·5	31·7	33·9	35·8	
Average sizes of Crouch *C. glaucum*	11·0	20·3	25·2	27·6	29·8	

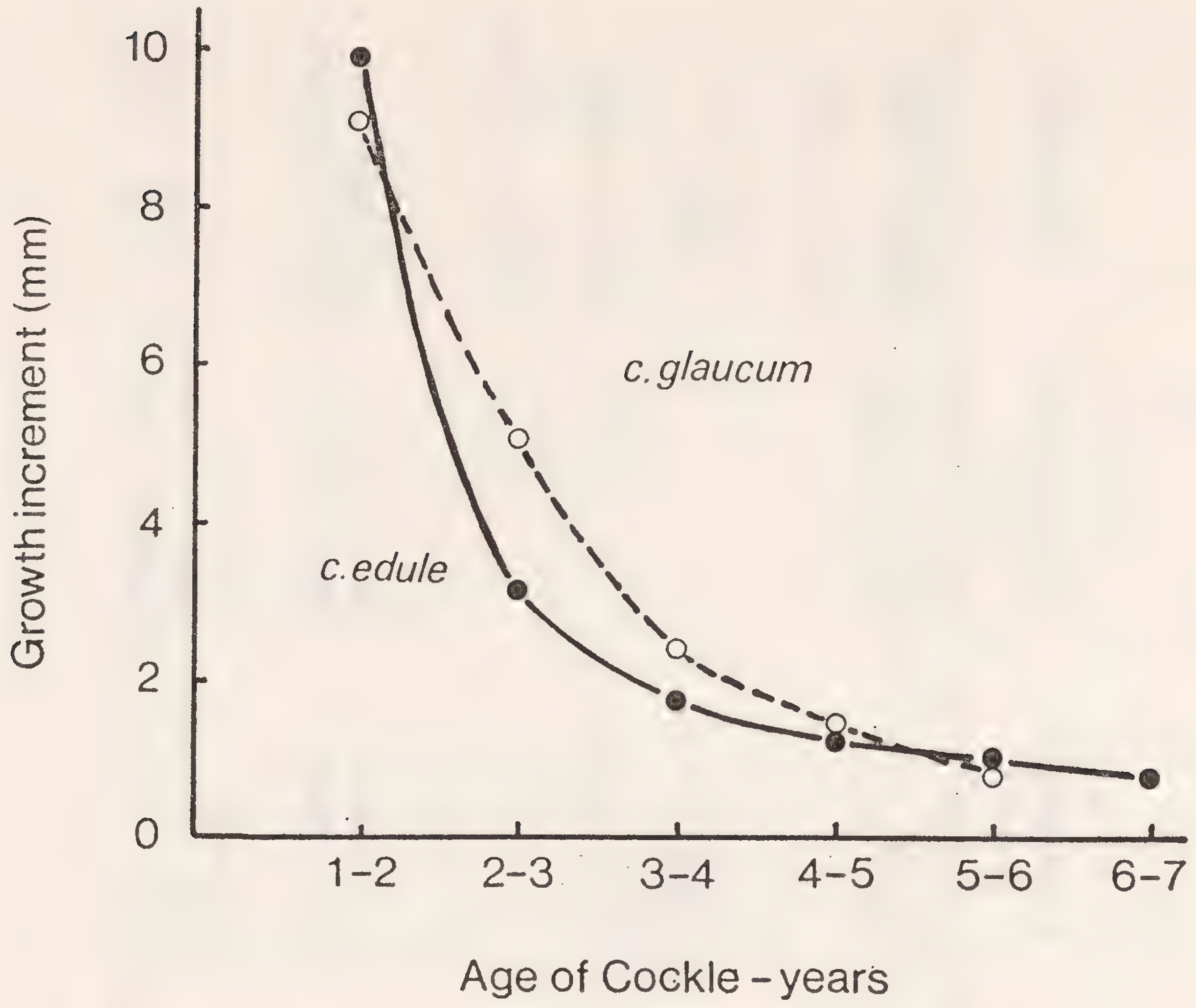

Fig. 4. Relative growth of *C. edule* and *C. glaucum* determined by measurement of annual additions to shell length (mm); ●——● *C. edule*, ○- - -○ *C. glaucum*.

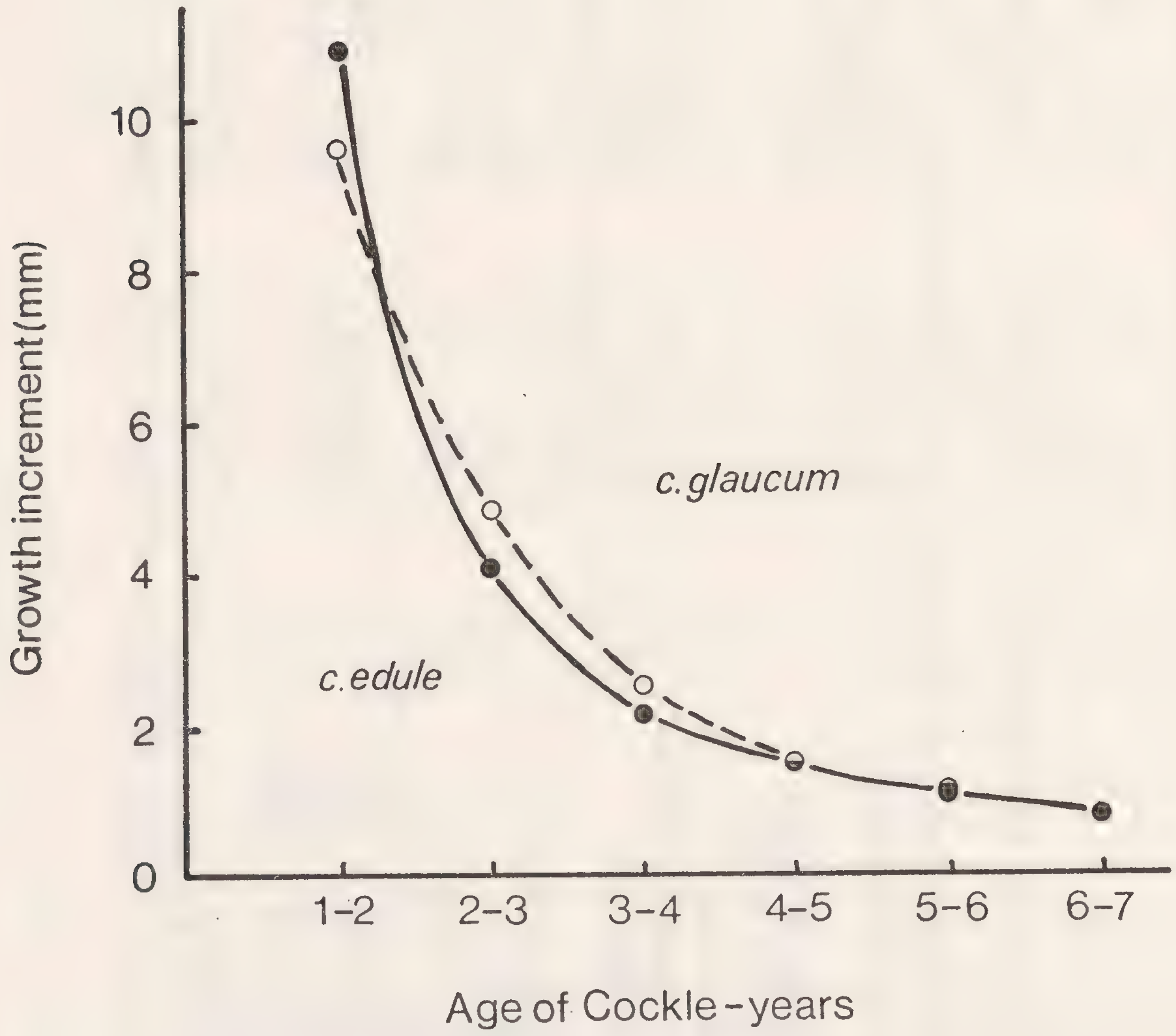

Fig. 5. Relative growth of the two *Cerastoderma* expressed as yearly increments to shell height (mm); ●——● *C. edule*, ○- - -○ *C. glaucum*.

Average growth increments

The average size increase between each annual ring, the relative growth rate, is graphed in Figures 4 and 5. Growth rates of the two cockles are very similar, thus observed differences in shell size are not due to differential growth rates throughout life.

It is evident that growth in the second summer (between the first and second annual ring), is slightly greater in *C. edule* than in *C. glaucum*, but that in subsequent years *C. glaucum* tends to grow faster. However, *C. edule* is already larger than *C. glaucum* by the end of the first year. It has been shown by Hancock (1967) studying the homogeneous population of *C. edule* from Llanrhidian sands "that the cockle population consists of fast-growing, late settled individuals and slow-growing early settlers". Subsequent growth differs in the two groups, those which added the largest increments in the first year grow the least in the second and following years, being overtaken by those whose initial growth was slow but whose growth rate in the second and succeeding years is rapid (Hancock, 1967). In the Crouch cockles the growth of *C. glaucum* overtakes *C. edule* in the third summer season, during the second to third year growth period.

From Tables 1 and 2 it is evident that large growth increments, which may occur in a favourable growing season, can be detected in the differently aged cockles. Thus a good growing season in the warm summer of 1964 is reflected in the second year growth (1st to 2nd ring) of five year cockles, the third year growth of six year old individuals, and the fourth year's growth of seven year cockles. The poor growing year of the cool 1967 summer for example is similarly reflected in the size of annual growth increments.

Comparison of shell lengths of Crouch cockles with other cockle populations

The range of sizes recorded in the literature for each age of *C. edule* are shown in Table 3. The Crouch cockles both *C. edule* and *C. glaucum* fall within the spectrum of sizes found elsewhere. As growth is obviously dependent upon many factors, of which food availability and temperature are probably the most important, it is not surprising that great variability is displayed in sizes of cockles from different environments.

DISCUSSION

The only other comparative studies available concerning growth rates and sizes of *C. edule* and *C. glaucum* are those by Høpner Petersen (1958), Eisma (1965), Muus (1967) and Rygg (1970).

Høpner Petersen (1958) in his initial work upon the biology of *C. edule* and *C. glaucum* (referred to as *Cardium lamarcki*) from Danish shallow water fjords, studied growth of *C. glaucum* in individuals up to 3 years old. Comparing the growth of *C. glaucum* with small samples of *C. edule*, he concluded that growth rate and maximum size appeared to be similar in the two *Cerastoderma*, a factor reiterated by Muus (1967). This later author records shell lengths of between

2–11 mm. for 0-year *C. glaucum* gathered from a bay north of Copenhagen and measured after cessation of growth in October. The Crouch *C. glaucum* exhibited growth rates slightly greater than the Denmark cockles, average sizes ranging from 8·9 to 12·7 mm. (total range 4–18 mm.) shell length by the first winter.

Høpner Petersen concluded his study by suggesting that spawning of cockles (he was considering *C. glaucum*) is probably influenced by food availability, as the timing of spawning was so different in cockles collected from localities having similar temperature régimes. In the Crouch estuary *C. edule* spawned during 1968 and 1969 when mean water temperatures had reached 12·9°C. and 13·2°C. respectively (Boyden, 1971a). For *C. glaucum* such correlation with temperature was not possible, weekly mean water temperatures of 16·7°C. and 18·4°C. being recorded at time of spawning in the two successive years. There also seemed to be no correlation with air temperature (19°C. and 22·5°C.) or with rapid changes in temperature. It would seem likely that factors other than temperature do indeed influence co-ordination of spawning in *C. glaucum*. Within single species populations, e.g. in the Danish *C. glaucum* populations studied by Høpner Petersen, 1958, and Muus, 1967, and also possibly in British lagoon populations of *C. glaucum*, a protracted period of spawning would have no effect on species individuality. However, in a sympatric association with *C. edule*, if a similar pattern was displayed then there would be a danger of hybridization. Limited and distinct periods of spawning by at least one of the cockles in a mixed population is essential for the maintenance of two individual gene-pools. Protracted spawning by Danish homogeneous populations of *C. glaucum* results in a wide size range of first wintering animals (2–11 mm.). The limited average sizes of Crouch *C. glaucum* (8·9–12·7 mm.) could reflect the shorter period of spawning (approximately one month) exhibited by this cockle when living sympatrically with *C. edule* in the Crouch estuary.

Eisma (1965) did not recognise the specific differentiation between *C. edule* and *C. glaucum* considering the latter to be a variety of *C. edule* (as *C. edule* var. *lamarcki*). From recent studies there is now no doubt that these cockles are related at a specific level (Mars, 1951; Høpner Petersen, 1958; Rygg, 1970; Boyden, 1971a, 1972; Russell, 1971; Boyden and Russell, 1972). Further, it is difficult to interpret Eisma's data because many of his cockle samples from Netherland waters contained varying proportions of the two *Cerastoderma*. We can deduce from his work, however, that in the *Cerastoderma*, growth increments, measured as increase of shell height for cockles in the 2nd summer varied from 6–14 mm. and in the 3rd summer (growth between 2nd–3rd rings) from 4·5–10 mm. Crouch *C. edule* grew on average 10·9 mm. and 4·1 mm. respectively over the two growing periods while *C. glaucum* correspondingly increased by 9·6 and 4·9 mm.

Eisma also attempted to relate longevity with environmental salinity, maintaining that oldest cockles were found in the highest salinities. Generally it is true that cockles from low salinity environments are smaller and younger than individuals living in more marine habitats. Both *C. edule* and *C. glaucum* reached a maximum age of 7–8 years in the Crouch estuary. Elsewhere, however, *C. edule* with 13 annual rings (58 mm. shell length) have been collected from Portland, Dorset. Large *C. edule* are well known from Orkney (maximum shell length 64 mm. and 14 years old, Cole, 1956—see also Winckworth, 1921; McMillan, 1971), from the Isle of Mull (59 mm.) and from the Scilly Isles (53 mm.). Seven year old *C. glaucum* have also been obtained from Western Ireland with a shell length of 54 mm, whilst Russell (personal communication) has collected *C. glaucum* of 63 mm shell length from a south-western Irish lagoon population. Size (and age) would appear to be greatest in cockles found on western, oceanic coasts, especially those *C. edule* from fully marine conditions, but also *C. glaucum* from lagoon habitats which are possibly regularly replenished with oceanic water during spring tides. In contrast within hypersaline environments such as Mediterranean étangs the maximum age of cockles (*C. glaucum*) is likely to be reduced, although growth itself may be promoted by high temperatures or alternatively regulated by food availability.

Studying a mixed *Cerastoderma* population at Trondheimsfjorden, Norway, Rygg (1970) measured the shell lengths of 0-year individuals during the autumn and in the subsequent spring. His data has been averaged and the following cockle lengths obtained:

Average length (mm) of 1968 brood.

	C. edule	*C. glaucum*	difference (mm)
Measured: in September 1968	2·01	2·43	0·42
in April 1969	2·94	3·37	0·57

Rygg suggests that because of the size differences shown above (and similar differences found in the sizes of 1967 spatted individuals) *C. glaucum* in this mixed cockle population spawns earlier than *C. edule*. The size differences shown above for Norwegian cockles could equally well be considered to indicate faster initial growth by *C. glaucum* in this northern fjord environment. This interpretation finds support in the fact that the difference in average size between the two cockles increases over a period of only a few months. If *C. glaucum* does spawn before *C. edule*, this is in contrast to the picture shown in the Crouch estuary where spawning of *C. edule* occurs prior to *C. glaucum*. However, it is irrelevant which cockle spawns first; what is important in the maintenance of a sympatric population is that spawning of the two species be distinctly separate.

CONCLUSIONS

1. The age structure of cockles from the Crouch estuary indicated a predominance of 4 and 5 year old cockles in May 1968 and showed a correlation in abundance with the cold winter of 1962/3. As the age structures of *C. edule* and *C. glaucum* were very similar, spawning success in this mixed population would also appear to be similar for the two cockles.

2. Considering individuals collected from this sympatric population, *C. edule* is always larger than *C. glaucum* for any given winter age group. Growth increments each summer, however, are very similar although *C. glaucum* over two years old grow slightly faster than *C. edule*.

3. The sizes of Crouch cockles both *C. edule* and *C. glaucum* achieved each winter fall within the range of values for *C. edule* available in the literature.

ACKNOWLEDGMENTS

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J. Conch. **27**: 490 (1972)

REVIEW

Sea Shells of Tropical West America Marine Mollusks from Baja California to Peru. 2nd ed. By A. Myra Keen, with the assistance of James H. McLean. Pp. xiv, 1,064; 22 col. pls.; about 4,000 illusts.; 6 maps. 8vo. Stanford University Press, 1971. Price $29.50.

When the first edition of Dr. Keen's work on the Mollusca of tropical West America appeared in 1958 (see *J. Conch.* **24**: 361–2) it at once became indispensable, and now we have a second, revised and enlarged, edition which will assuredly also become indispensable. Its geographical range has now been extended to cover the Mollusca from Baja California to north-west Peru and also the Galapagos islands. A number of additional species, mainly microscopic or deepwater, have been described and many of them figured, bringing the total number of species enumerated up to approximately 3,325, nearly twice as many as in the first edition. Opisthobranchiate and nudibranchiate mollusks, formerly omitted, are now included and twelve additional colour plates illustrate their wide diversity of colour and form, as well as a variety of living gastropods and lamellibranchs.

As in the first edition figures are usually on the same page as the relevant text or very near to it, making reference from text to figure pleasantly easy. Many additional photographs of type specimens in the British Museum (Nat. Hist.) and the U.S. National Museum are now included.

There is a 9-page appendix of rejected and indeterminate species into which Sargasso Sea have drifted the victims of incorrect labels, misplaced labels, and insufficient data. Anyone working with old museum material finds such "doubtful" species only too often and Dr. Keen's list is a great help towards their correct allocation.

The extensive bibliography covers items published as late as 1971 and supplies a wealth of bibliographic information. There are also six maps of the area, a topographical index and a glossary—all most welcome features. One is particularly pleased to find a really comprehensive index.

The book, despite its size (1,064 pp. and 22 col. pls.) is not unwieldy nor is the text cramped in appearance. To have dealt adequately with such a very large number of genera and species within the compass of a thousand pages is indeed a feat and we must be properly grateful to Dr. Keen.

Nora F. McMillan

J. Conch. **27**: 491–496 (1972)

MARINE MOLLUSCA FROM BAHRAIN ISLAND, PERSIAN GULF

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(*Read before the Society* 18 *March* 1972)

Between early May and the end of July 1971, Major M. D. Gallagher, occasionally assisted by two friends, Mr. T. D. Rogers and Mr. M. C. Jennings, undertook the task of searching for marine mollusca along the coast of Bahrain. Though Major Gallagher is well known in other spheres of natural history neither he nor his friends had any conchological knowledge when they started; their achievements in the short time available were very good. Their findings are listed below in a preliminary form.

The Bahrain Islands are situated in a shallow sea and much of the coastline is bordered by flat "fasht" areas (coralline limestone outcrops containing multitudinous fossilised cerithids) exposed at low tide and used locally for building etc. The east coast has more seaweed than the west, especially south of the oil refinery near Ras Salba where the intertidal zone is covered by spongy weed and heavily polluted by waste products from the refinery. Further south the weed lessens. Due to undersea fresh water springs the degree of salinity of the sea water is lower to the north of the islands. Sea temperatures are high and waves of up to eight feet in height can sometimes occur.

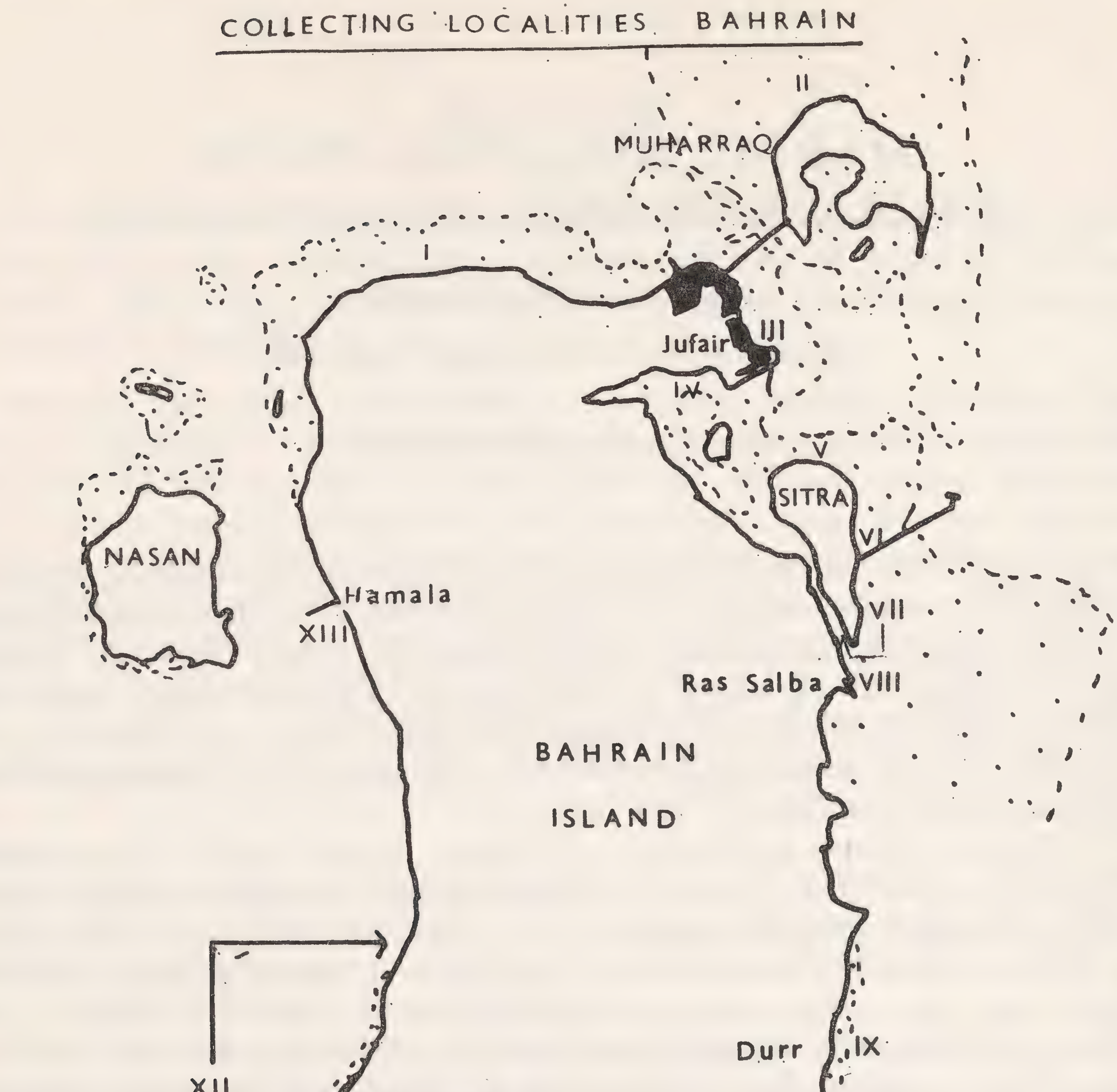
In the time between May and July thirteen localities were examined for molluscs and for convenience I have allocated them numbers (see sketch map).

I. The north coast. A sea bottom of "fasht" mostly covered by silt or sand and scattered with fragmentary rocks of local origin.

II. Off Muharraq Island. As above but with pools caused by the mining of the "fasht", some weed, and fishtraps on which were found some molluscs.

III. Off Jufair. A flat sea bed covered with debris, silt, weed and some small rocks, very polluted by the effluents from the local village and the local shipping but apparently much to the liking of the local molluscs.

IV. Streams leading into a mangrove swamp near Bu Ashira and the swamp itself: an area of thick but not very deep mud and small mangrove bushes. In the lower reaches of the streams *Potamididae* and *Planaxidae* formed a carpet and were also in small groups on the shallow banks exposed at low tide. Some


COLLECTING LOCALITIES BAHRAIN
II
MUHARRAQ
I
Jufair
III
IV
V
SITRA
VI
VII
NASAN
Hamala
XIII
Ras Salba
VIII
BAHRAIN
ISLAND
XII
Ras Noma
Ras al Jazayir
Durr
IX
Ras al Qarain
X
fasht areas
0 1 2 3 4 5 6 7 8 miles
Ras al Barr
XI

unusual and interesting bivalves were on the mangroves and in the mud near the low tide line.

V. A sandbank north-east of Sitra Island exposed at low tide and surrounded by up to five feet of water over a bottom of clean sand, small rocks and some exposed "fasht", the whole area being subjected to a strong tidal flow which probably deposited the many dead bivalves found here.

VI. Off the causeway leading to the wharf and artificial island off Sitra Island. Firm sand and small rocks and, a long way out, larger rocks. A good area for molluscs.

VII. A tidal channel with a bottom of thick silt. Few molluscs.

VIII. Ras Salba. A fairly flat promontory with a muddy foreshore and an area inland confused by mining for sand and salt, with several raised banks, on one of which, some forty to fifty yards from the sea and unaffected by normal tides, was a deposit of long exposed *Murex*, *Strombus* and a gigantic *Thais carinifera*.

IX. Durr. A beach thick with shell debris and with some rock (not "fasht") exposed at low tide. Plenty of eel grass.

X. Ras al Qarain. Clean grey sand about an inch deep over a black layer. Eel grass patches.

XI. Ras al Barr. As above.

XII. A sea bed of sand, silt and small rocks on "fasht". A rim of shell debris in the splash zone yielded numerous small to minute dead molluscs.

XIII. Hamala sewer outfall. "Fasht" and very dirty conditions. Very few molluscs.

Systematic list of species:

Species		*Area found*
Fissurellidae	*Diodora funiculata* (Reeve)	II (live), X, XII
	Diodora funiculata subsp. ?	XII
	Diodora quadriradiata (Reeve)	XII
	Diodora rüppelli (Sowerby)	XII
Trochidae	*Euchelus asper* (Gmelin)	II, III, IV, V (live)
	Minolia holdsworthiana Melvill	XII
	Trochus erythraeus Brocchi	V, X (live)
	Monilea obscura (Wood)	All areas (live)
	Umbonium vestiarium (L.)	X (live)
Turbinidae	*Turbo coronatus* Gmelin	II, III, IX X (live)
Phasianellidae	*Phasianella jaspidea* (Reeve)	X, XII, XIII
	Tricolia fordiana Tryon	XII

Rissoidae	*Rissoina distans* (Anton)	XII
Littorinidae	*Nodilittorina subnodosa* (Philippi)	I, IX, XII (live)
Vermetidae	*Vermetus sulcatus* Lamarck	III, IX, XII (live)
Planaxidae	*Planaxis sulcatus* (Born)	I, II, III, IV, IX, X, XII (live)
Potamididae	*Pirenella caillaudi* Potiez & Michaux	II, III, IV, V, IX, X, XI (live)
	Pirenella conica (Blainville)	I, III, IV (live)
Cerithiidae	*Cerithium morus* (Lamarck)	III, V (live)
	Cerithium petrosum Wood	III (live)
	Cerithium rugosum Wood	I, II, III, IV, V, IX, X, XII (live)
	Cerithium rüppelli Philippi	V, XII (live), I, IX, X
	Cerithium scabridum Philippi	Ubiquitous! (live)
	Rhinoclavus fasciatum (Bruguière)	XII
Cerithiopsidae	*Cerithiopsis* (*Seila*) *hinduorum* Melvill	XII
Cerithididae	*Cerithideopsis cingulatus* (Gmelin)	I, II, III, IV (live), XII
	Diala sulcifera A. Adams	X, XII, XIII
	Diala semistriata (Philippi)	IV, X, XII
	Alaba virgata (Philippi)	XII
Strombidae	*Strombus decorus* (Röding) Subsp. *persicus* (Swainson)	VI, VIII
Cypraeidae	*Cypraea* (*Erosaria*) *turdus* (Lamarck)	X (one only)
	Cypraea (*Paulonaria*) *gracilis* Gaskoin	I (one only)
Muricidae	*Chicoreus* (*Hexaplex*) *kürsterianus* Tapparone Canefri	III, IV, XII (live), VIII, IX, X
Thaisidae	*Murex scolopax* Dillwyn	XII
	Thais carinifera (Lamarck)	VIII
	Thais pseudohippocastanum (Dautzenberg)	II, III, VI (live)
	Thais tissoti (Petit)	III, V, VI (live)
	Thais margariticola (Broderip)	V, VI, XII (live)
	Drupa tuberculata Blainville	XII (live), XIII
Columbellidae	*Mitrella blanda* (Sowerby)	I, II, III, X, XII (live)
Nassaridae	*Nassarius pullus* (L.)	III, VI, X (live)
Olividae	*Ancilla cinnamomea* (Lamarck)	III, V, IX, X, XIII
	Ancilla fasciata (Reeve)	V (live), XII
Fasciolariidae	*Fusinus arabicus* Melvill	IX
Marginellidae	*Marginella* (*Persicula*) *mazagonica* Melvill	XII
Bullidae	*Bulla ampulla* (L.)	II, VI, X (live), XI, XII
Scaphandridae	*Atys cylindrica* (Helbling)	X, XII
Pyramidellidae	*Turbonilla* (*Nisiturris*) *icela* Melvill	XII
Siphonariidae	*Siphonaria rosea* Hubendick	III (live), II, IV

Arcidae	*Arca lacerata* (Bruguière)	IX
	Arca plicata Dillwyn	XII
	Arca uropigmelana Bory de St. Vincent	V
	Barbatia helblingi (Bruguière)	V (live), X, XII
Mytilidae	*Brachidontes variabilis* (Krauss)	III, IV, V, XII, XIII (live), X
Pteriidae	*Pinctada radiata* (Leach)	III, XII (live)
	Pinctada radiata var.	XII (live)
	Pinctada radiata var.	XII
Pinnidae	*Pinna atropurpurea* Sowerby subsp.?	Landed by fishing boat
Ostreidae	*Plicatula plicata* (L.)	III (live)
Isognomonidae	*Isognomen legumen* Gmelin	VI (live)
	Malleus regula Førsskal	V, IX (live), XII, XIII
	Parviperna dentifera (Krauss)	II (live)
Pectinidae	*Chlamys senatorius* (Gmelin)	V
	Chlamys ruschenbergerii (Tryon)	V (live)
Spondylidae	*Spondylus aculeatus* Schroeder	IV (live)
	Spondylus gloriandus Melvill	V, XII
	Spondylus townsendi Sowerby	V
Cressatellidae	*Cuna* sp.*	XII
Carditidae	*Mytilicardita* (*Beguina*) *gubernaculum* (Reeve)	IX
Lucinidae	*Loripes fisheriana* Issel	X, XII
	Anadontia edentula (L.)	XII
Cardiidae	*Trachycardium maculosum* (Wood)	XII
	Trachycardium lacunosum Reeve	V, VI, X, XII
	Laevicardium papyraceum (Gmelin)	XII
Veneridae	*Gafrarium arabicum* (Lamarck)	II, III, V, VI (live), IV, IX
	Gafrarium callipygeum Born	II, V (live)
	Gafrarium divaricatum (Gmelin)	III (live)
	Circe scripta (L.)	V
	Meretrix meretrix (L.)	X (live), XI, XII
	Sunetta effossa (Hanley)	V (live)
	Venerupis deshaysei (Hanley)	V
	Timoclea sp.*	XII
Psammobiidae	*Gari* (*Psammobia*) *occidens* Chase	V
Mactridae	*Mactra olorina* (Philippi)	V
Trapeziidae	*Trapezium sublaevigatum* Lamarck	IV (live)

* Species named by Biggs in a Bulletin of the British Museum (Natural History) in the press (April 1972)

There remain many specimens to be identified, mostly small to minute or rare and possibly new species. One *Clanculus* is near to *Clanculus tristis* "Ceylon" in the British Museum (no other details are recorded). *Vermetus sulcatus* is a new record for the Persian Gulf. Regarding the uncommon *Trapezium sublaevigatum* it is of interest to note that Mr. Jennings observed that it was attached by a byssus and that he and Major Gallagher recorded that it was numerous in the somewhat unsalubrious conditions in which it lived. Perhaps it is not that the mollusc is uncommon but that searchers of odorous mangrove swamps are!

My very grateful thanks are due, not for the first time, to the Rev. H. E. J. Biggs, F.L.S., for his patient assistance in identifying the mollusca in the above list and his encouragement in the writing of this paper. They are also due to Major Gallagher for his painstaking collecting and meticulous observations, to Mr. Jennings and Mr. Rogers, his assistants, and to Mr. E. M. Venables, F.R.G.S., Director of the Bognor Regis Natural History Museum, for allowing me the unlimited use of the Museum's library.

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J. Conch. 27: 497–502 (1972)

REPORT ON THE MARINE MOLLUSCA COLLECTED BY THE BRITISH DAHLAK QUEST EXPEDITION, RED SEA, 1969–1970

H. E. J. Biggs

48 Park Road, Bromley, Kent

(*Read before the Society*, 18*th March* 1972)

The Dahlak Archipelago has been visited on a number of occasions and shells collected. The Austrian Research Vessel "Pola" visited the islands in 1897 and the mollusca collected were reported upon by Sturany (1901, 1903). In 1960 the Warsaw University Expedition ("Dar Opola") made collections on the islands and were reported on by me (Biggs, 1965) for the shells collected on Entedebir I. In 1962 the Israel South Red Sea Expedition called at the Archipelago and shells of the genus *Conus* were dealt with by Kohn (1965).

A more recent expedition is the British Dahlak Quest Expedition (1969–1970) mounted by the Scientific Exploration Society and led by Major John Blashford-Snell. It is the smaller mollusca collected which have been entrusted to me for report. The larger species have been determined by Mrs. Molly Hill, an associate member of the Expedition.

A report on the hydrography of the Archipelago based on the researches of the Israel South Red Sea Expedition was published by Oren (1964) and this forms a good background to the study of the habitats and ecological conditions under which the mollusca live.

The Dahlak Islands are a group which are said to consist of 125 ranging from large ones such as Dahlak Kabir to some so small as to be no more than the exposed tips of submerged rocks. The group extends from about 16° 38′ to 15° 17′ north latitude. They cover a total area 120 miles long and 80 miles broad. Only a few of the larger ones were visited by the Expedition and only mollusca collected on the following islands is here reported on; Dalcus, Dehul, Dissai, Norah, Kad Norah, Nocra, Dahlak Kabir and Entedebir.

The beach sample collected by Mrs. Hill was taken along half a mile of beach on the side of Dehul I. facing north-west. This has yielded a considerable number of species, but in a few cases only one example, often rather worn, the determination of which would take some time and would have delayed the publication of this report. These, and a few others, will be returned to the Natural History Museum, Haile Selassi I University at Addis Ababa.

The order adopted in this work is that of Thiele (1929–1931).

Diodora rüppelli (Sowerby). Kad Norah I. six samples dead.

Cellana rota (Gmelin). Dissai I. three examples on rocks just below low water level, live.

Turbo coronatus Gmelin. Dahlak Kabir I. three examples very strongly gemmulated, probably juveniles.

Nerita albicilla Linné. Dehul I. about seven examples in beach sample.

Nerita undata Gmelin. Dissai I. eight examples probably live.

Phenacolepas granocostata Pease. Dehul I. beach sample eleven examples. Several examples were also collected on Entedibir I. by the "Dar Opola" Expedition but were not determined at the time of publication of my paper.

Phenacolepas arabica (Rüppell MS.) as *Scutellina arabica*. H. and A. Adams (1853–58) as *Scutellina* nomen nudum H. A. Pilsbry (1890) *Scutellina* nomen nudum.

Material. Three examples, locality unknown, B.M.(N.H.) Mus. Cuming.

One example, Kad Norah I. Dahlak Is., Red Sea, 1970. Description. Shell white, thin, somewhat elongated oval, closely, finely and evenly ribbed, the ribs having numerous spines (thornlike in paratype A.); apex smooth and pointed posteriorly and placed about $\frac{1}{8}$ of the length of the shell from the posterior end; base of the shell a shallow arc when viewed from the side, crenulated; interior white somewhat shining, ribbed.

Holotype. B.M.(N.H.) No. 19724, length 16·0 mm., breadth 11·4 mm.
Paratype A. B.M.(N.H.) No. 19725, length 13·5 mm., breadth 10·1 mm.
Paratype B. B.M.(N.H.) No. 19726, length 17·2 mm., breadth 12·0 mm.
Paratype C. Kad Norah I. example, length 17·3 mm., breadth 11·0 mm.
Type locality, Red Sea (by inference).

The Holotype and Paratype A are selected for their freshness although Paratype B is the largest of the series, it is perhaps a little worn. Paratype C is more elongate in general shape and may be from a different locality than Rüppell's examples. The collector's note in this latter specimen is "on rocks" but the shell appears to be a dead example; it is numbered by Mrs. Hill D.I.29.

The three examples in the B.M.(N.H.) were stuck on a tablet with Rüppell's name in a large hand on the front. On the back was a smaller name label in the hand of one of Cuming's clerks. This was stuck on a larger white label bearing the words "S. arabica Ruppell M.S.? Adams Gen. i. 461". On the bottom left hand corner "M.C."

It is known that Rüppell (1794–1884) was in communication with Hugh Cuming (Dance, 1966 : 154) and it was assumed with some degree of certainty that these examples reached Cuming from Rüppell himself with his MS. name. As he travelled widely in the countries round the Red Sea and named this species "arabica" they were most likely from that region.

H. and A. Adams (1857 : 461) when listing the genus *Scutellina* (as Phenacolepas was then named) put *arabica* Rüppell first. Pilsbry (1900 : 6) when erecting the new name of the genus includes this species as "*Scutellina arabica* Rüppell" and then refers to H. and A. Adams record as a "nude name" but he gives no indication or opinion as to the origin of Rüppell's name or if it had been validated by anyone at that time.

Sturany (1903 : 266) records the species as "*Scutellina* (?) *arabica* Rüpp." from locality 20 i.e. "Sherm Habban (Abban) 12 Jannar 1896" which lies between 28° and 26° N. Lat.

It is therefore desirable to validate this name *arabica* for this Red Sea species by re-description and figure (see Plate XVIII).

Viviparus (*Bellamya*) *unicolor* Oliver. Dissai I. one dead shell. As this island is close to the mainland it is just possible that this dead and bleached shell is a chance importation. At the same time the possibility that it is a survival from some freshwater habitat on the island from times past must not be excluded.

Littorina scabra Linné. Dahlak Kabr, Erwé Mangrove swamps, one live example.

Peasiella isseli (Semper in Issel). Dehul I. beach sample three dead shells. This species has now been identified, but not previously recorded, from the beach samples from Entedebir I. in the "Dar Opola" material.

Tectarius natalensis (Philippi). Two worn juveniles in shell sand from an unrecorded locality.

Amphithalamus sp. From Seheila on Norah I., one example in shell sand.

Rissoina distans Anton. Dehul I. six examples in beach sample.

Rissoina bouvieri Jousseaume. Dehul I. one example in beach sample.

Rissoina seguenziana Issel. One example collected on a *Pinna* sp. in 3 ft. of water on Nocra I. In the beach sample from Dehul I. eight worn examples.

Torinia variegata (Gmelin). Dehul I. beach sample several examples. Recorded from Entedebir I. (Biggs, 1965 : 337) as a Helicarius, by Shopland for Aden (1902 : 174) as a *Solarium* and by Sturany (1903 : 259) as a *Torinia* for five localities in the Red Sea.

Caecum (*Caecum*) cf. *sepimentum* de Folin. Dehul I. four fresh examples sifted from beach sample and now in my collection and there are a number in the Department of Zoology at Haile Selassi I University. I have given this name, tentatively, as they are very close to examples of this species in the B.M.(N.H.) from the Winckworth collection from Karachi and Mauritius. Although the labels are in his hand the specimens may not have been collected by himself. I am grateful to Dr. R. D. Moore for his comments on these examples. He does not agree that they are *sepimentum* of de Folin and gives his reasons but adds (in Litt.) "... I would not know what to call it." This genus is not a popular one with collectors and is little studied so it may well be that this is an undescribed species. However in view of Dr. Moore's expert opinion we must proceed with caution.

Caecum (*Brochina*) *arabicum* Issel. Dehul beach sample, nine specimens and some fragments; some examples also in Addis Ababa from the Dehul beach sample. The species was described by Issel (1869 : 296) and figured by him from two examples in the Turin Museum. Moazzo (1939 : 179 and Fig. 16) under the caption "*Caecum arabicum* Issel" seems to figure a species more like *sepimentum*, that is with prominent ribs, than Issel's *arabicum* which has very faint ribs if any. Some examples from Dehul beach have some periostracum.

Planaxis sulcatus Born. Dehul I. seven juvenile examples.

Modulus tectum Gmelin. One shell from near Nocra on Dahlak Kabir I.

Pirenella sp. cf. *caillaudi* Potiez and Michaud. Dalcus I. In the Mangrove swamps three live examples and a number of dead shells. From Dehul I. large numbers of a small species of *Pirenella.*

Scaliola arenosa A. Adams. Dehul I. beach sample twelve examples: this series seems to grade into *S. elata* (Semper in Issel).

Cerithium schröteri Mörch (= *Cerithium caeruleum* Sowerby). Four examples from Norah I. I am using the older name for this species following Winckworth.

Cerithium erythraeonense Lamarck. Dissei I. one example of a rather small form of the species.

Cerithium piperatum Sowerby. Dehul I. twenty-four examples.

Cerithium morus Lamarck. Dehul I. one example.

Cerithium shoplandi Melvill. Norah I. four examples on sand and on algae in shallow water, live.

Diala striata Philippi. The beach sample from Dehul I. contained some of this species besides a number of other Dialae.

Dahlakia leilae Biggs.

Dahlakia jugosa Biggs.

Dahlakia striata Biggs.

On Dehul I. Mrs. Hill collected a very large sample of mollusca along half a mile of beach which contained all three of these species. There were over 1,000 examples of the genus but many of them show signs of a combination of characters of the species. Recently a large sample of shells of this genus have been collected by Mr. A. Woodhead from a beach 30 miles north of Port Sudan. A study of these has extended the range of variation in the forms of this genus and until more work has been done little more can be said at the present time.

Triphora cingulata A. Adams. From Saheila on Norah I. one example.

Triphora cf. *acuta* Kiener. Although the one example from Saheila is larger than examples I have seen from other localities I think it can be referred to this species.

Scalaria (*Parviscala*) *concinna* Sowerby. Dehul I. beach sample contained eleven examples of this species. They have been determined from a shell bearing the above name in the British Museum (Natural History) which could well be Sowerby's holotype from the Cuming collection. Several other species have been described by later authors which come very close to it, if not identical with it. I have, therefore, adopted Sowerby's name as having priority.

Janthina sp. cf. *fragilis* Linné. This specimen is a juvenile shell and too young for determination. Sturany (1903 : 259) records *fragilis* from Perim I.

Oscilla sp. From Dehul I. one adult and three juveniles; as neither Sturany of Moazzo record any species of this genus from the Red Sea, it is better to record the genus without a trivial name. There are probably more examples of this species in Addis Ababa University.

Pyramidula (*Otopleura*) sp. From Dissei beach two dead shells.

Siphopatella walshi (Hermannsen). One live shell on a rock on Nocra I.

Cypraea (*Palmadusta*) ? *microdon* Gray. This species is recorded with some reserve; Mrs. Hill notes "on dry land, one mile inland" on Dahlak Kabir. It is a worn specimen.

Triva oryza (Lamarck). Dehul I. six samples. Sturany (1903 : 255) records the species from no less than eighteen localities from the Gulf of Aqaba to Zabayir I. and one of these is the Dahlak Archipelago.

Cymatium (*Gelagna*) *clandestina* Lamarck. Dissei I. One example, dead shell but in very fresh condition.

Rapana bulbosa Lightfoot. Dahlak Kabir I. three dead shells.

Drupa sp. cf. *margariticola* Brodrip. Dissei I. two examples, one live.

Thais pseudohippocastanum Dautzenberg. Dahlak Kabir I. six examples, ranging from 17 mm. to 40 mm. in height and all with strong nodules.

Pyrene (*Seminella*) sp. In the Dehul I. beach sample 5 shells which are close to Melvill's species *phaula* from the Persian Gulf.

Engina mendicaria (Linné). Nocra I. one dead, but fresh, example.

Volema (*Volema*) *pyrum* (Gmelin) ssp. *nodosa* Lamarck. Many juveniles from Dehul I. in all stages of growth; Dahlak Kabir I. two adults and one juvenile.

Nassarius paupera (Gould). In the large sample of *Dahlakia* spp. were two examples of this species. I am grateful to Mr. C. P. Nuttall of the British Museum (Natural History) for confirmation of this determination. The species ranges from the Gulf of Aqaba to Perim I. but seems to be rather a rare species.

Nassarius pullus (Linné). Two adults in the Dehul I. beach sample.

Nassarius auricularis (Linné). One adult in the Dehul I. beach sample.

Nassarius albescens Dunker. Two examples in the Dehul I. beach sample.

Ancilla eburnea (Deshayes). Two examples in the Dehul I. beach sample. Although this species is not mentioned by Issel, Sturany or Moazzo for the Red Sea area there are examples in the Lord Collection in B.M.(N.H.) from the Gulf of Suez.

Ancilla exigua (Sowerby). Dehul I. beach sample one example.

Cylindra crenulata (Gmelin). Dehul I. one example.

Persicula mazagonica Melvill. Dehul I. common in the beach sample.

Marginella terveriana Pettit. Dehul I. common in the beach sample.

Haminea vitrea A. Adams. Dehul I. beach sample ten examples ranging from 8·7 mm. to 3·2 mm. in height.

Retusa (*Pyrunculus*) sp. One example found inside a dead shell is very like *R. pellyi* Smith from the Persian Gulf but this species has not yet been recorded for the intervening seas.

Pedipes afer (Gmelin). Dehul I. one example found.

Laemodonta rapax Dhorn. One example in the beach sample from Dehul I.

The species recorded by me (1965 : 339) as *Laemodonta bicolor* (Pfeiffer) with some doubt is now corrected to *rapax* of Dhorn.

Allochroa bronni Philippi. One example in the Dehul I. beach sample.

Melampus lividus (Linné). Dehul I. beach sample twenty-seven adults and several juveniles, beach worn.

Siphonaria cf. *kurrachiensis* Reeve. In the Dehul Beach sample ten examples of a species of Siphonaria were found which appear to be this species of one closely related.

ACKNOWLEDGMENTS

My thanks are due, mostly, to the leaders and members of the expedition, and especially to Mrs. Molly Hill, who collected the material for this report and for doing the preliminary sorting. Also to Mr. C. P. Nuttall of the Department of Geology at the British Museum (Natural History) for help with the determination of the species of *Nassarius* and to Dr. Donald R. Moore of the University of Miami for his advice on *Caecum*. My thanks are also due to Mr. J. F. Peake, in charge of the Mollusca Section of the Department of Zoology in the British Museum (Natural History) for facilities to study the collections in his charge and also for the photographs of the *Phenacolepas arabica* in his care and which are here reproduced.

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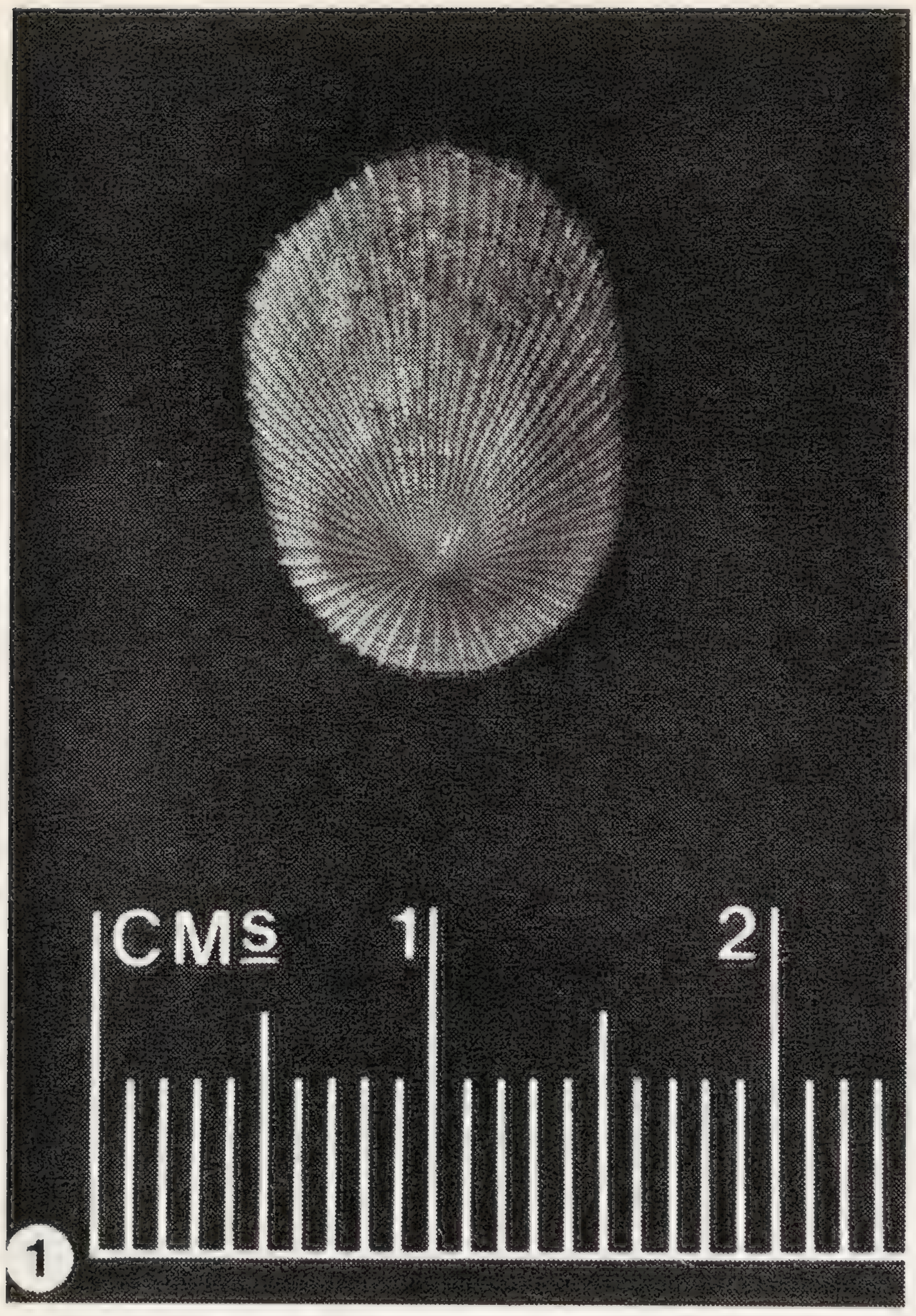
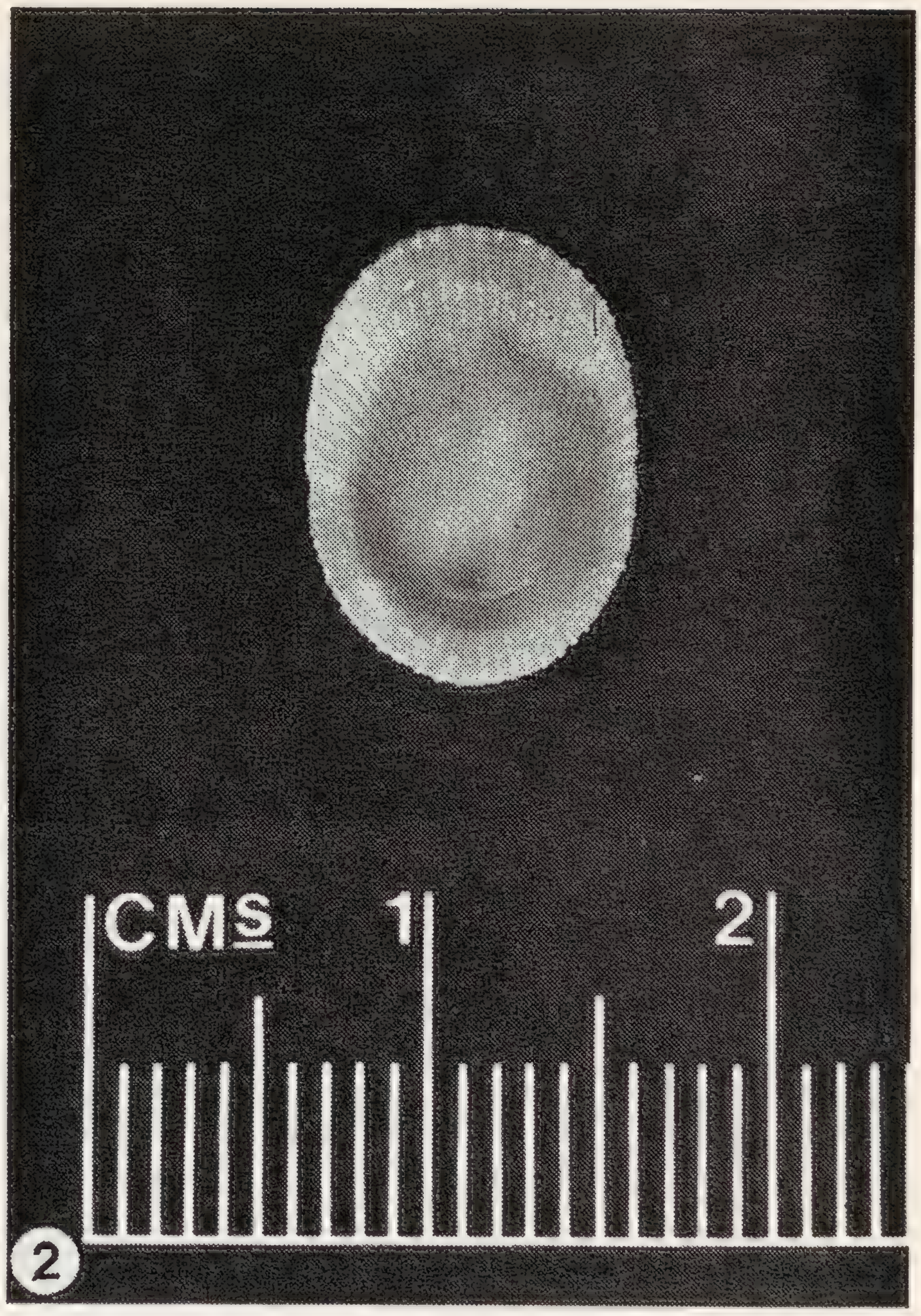
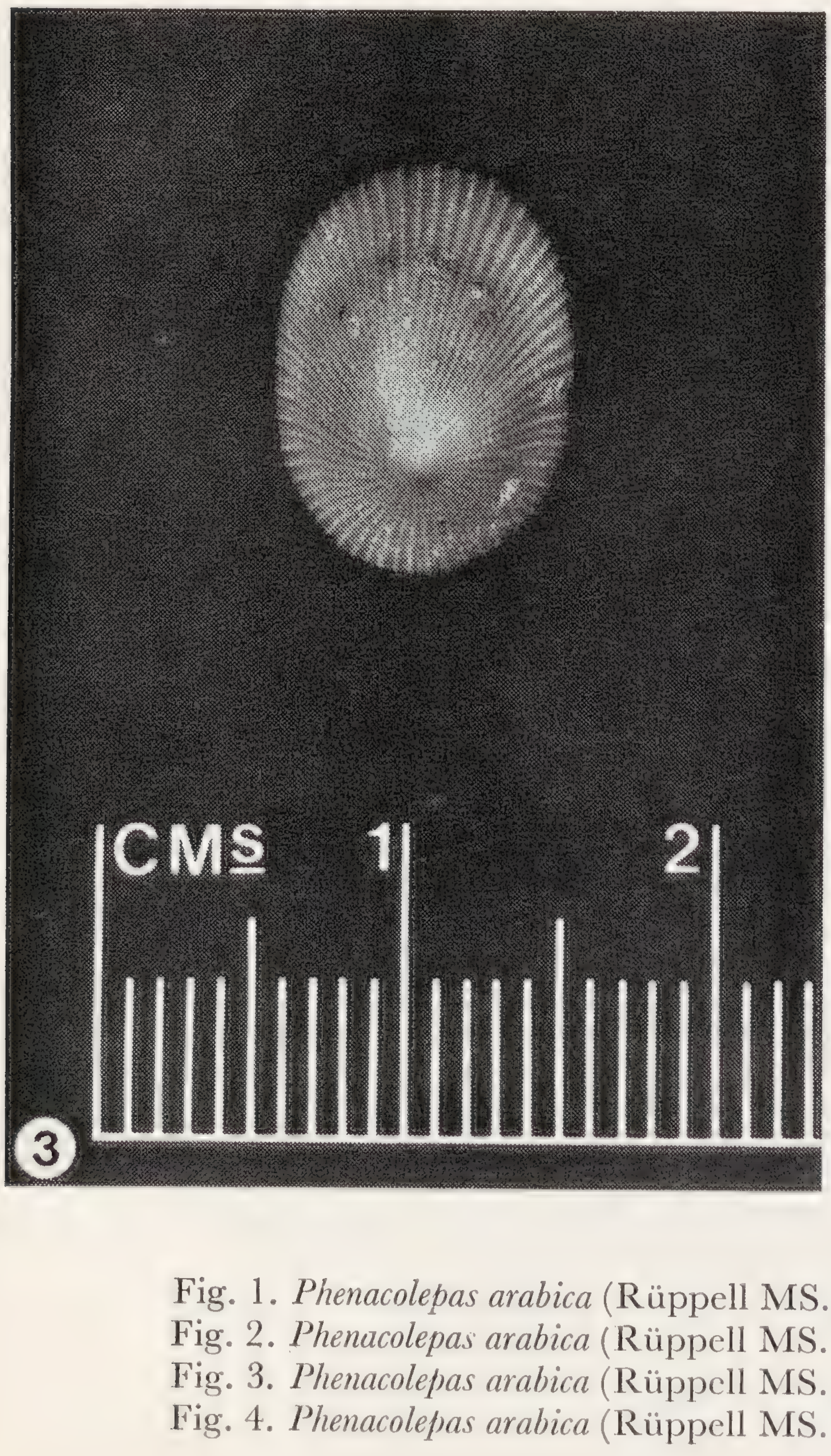
PLATE XVIII







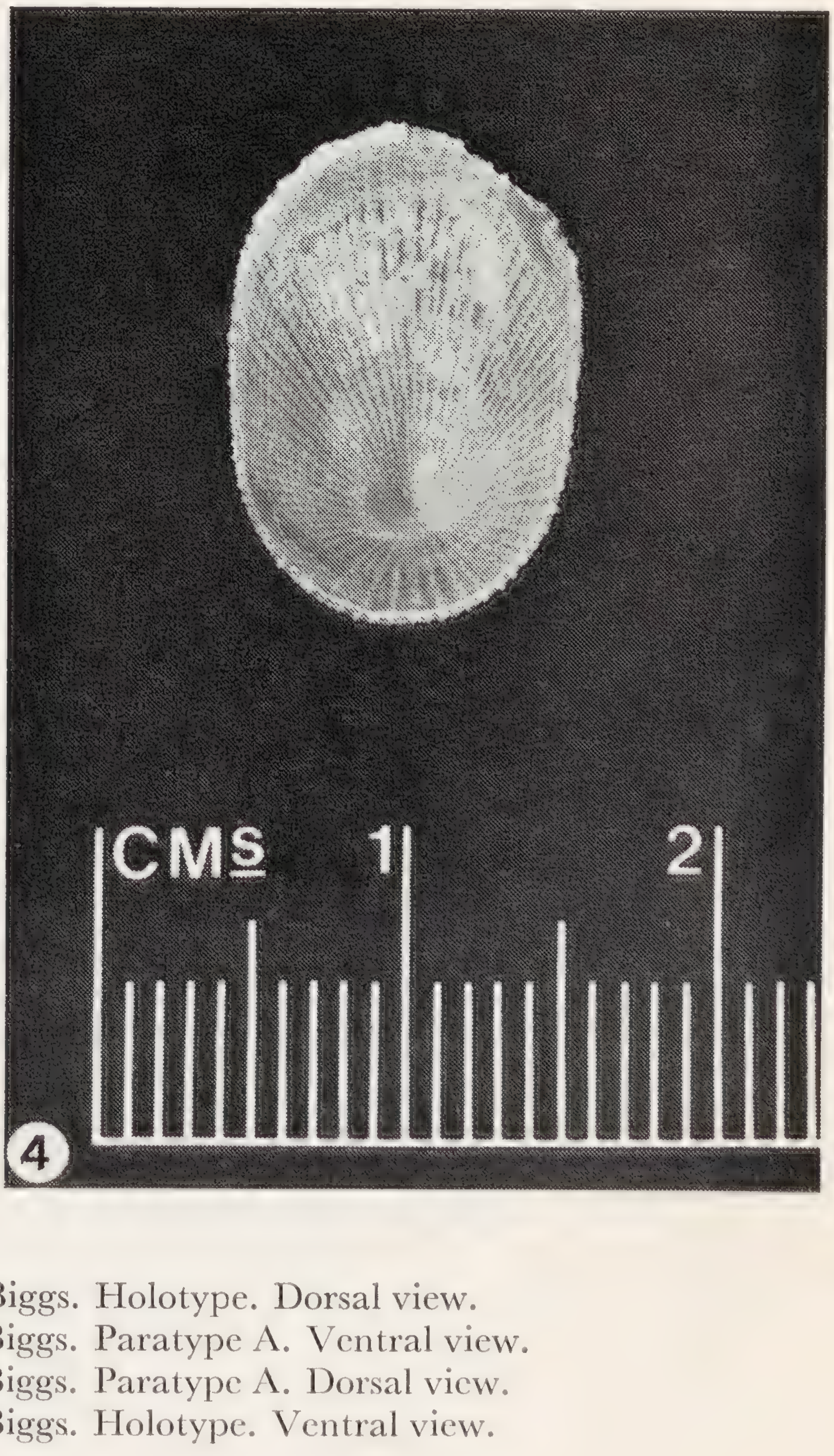
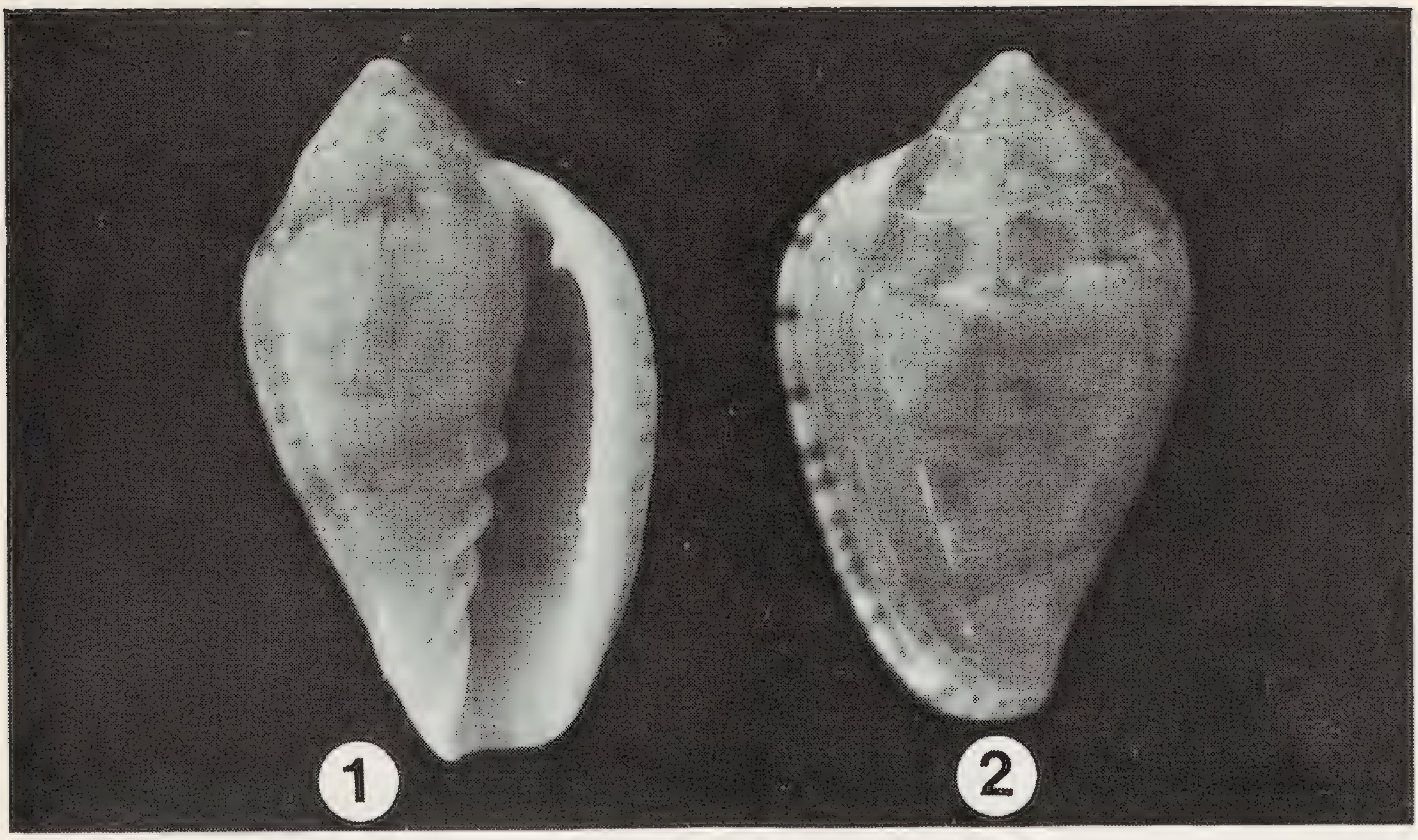


Fig. 1. *Phenacolepas arabica* (Rüppell MS.) Biggs. Holotype. Dorsal view.
Fig. 2. *Phenacolepas arabica* (Rüppell MS.) Biggs. Paratype A. Ventral view.
Fig. 3. *Phenacolepas arabica* (Rüppell MS.) Biggs. Paratype A. Dorsal view.
Fig. 4. *Phenacolepas arabica* (Rüppell MS.) Biggs. Holotype. Ventral view.

Plate XIX

HUBERTI



CANARYENSIS

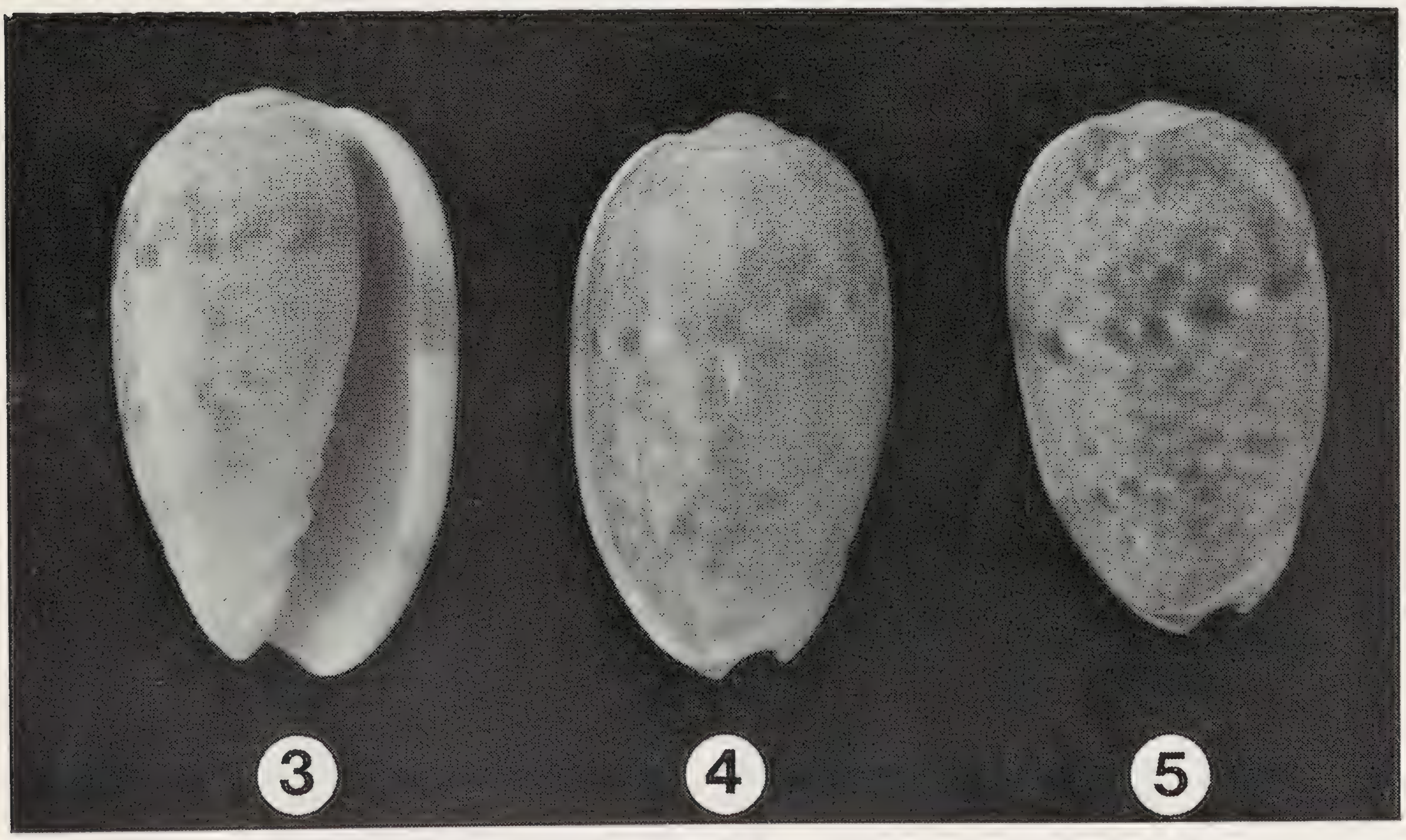


Fig. 1. *Marginella huberti* sp. nov. Holotype.
Fig. 2. *M. huberti* sp. nov. Paratype.
Fig. 3. *Persicula canaryensis* sp. nov. Holotype.
Figs. 4 and 5. *P. canaryensis* sp. nov. Paratypes.

J. Conch. **27**: 503–504 (1972)

TWO NEW SPECIES OF MARGINELLIDAE FROM WEST AFRICA

Phillip W. Clover

Rota Cadiz, Spain

(*Read before the Society,* 18 *November* 1972)

Marginella huberti sp. nov. Figs. 1, 2

Description of Holotype. Shell medium sized, ovate-pear shaped; bluish ash-colour with numerous grey dots forming axial and waved lines over entire shell; with two distinct spiral bands of darker grey colour, one extending from suture to shoulder on body whorl, the second on the anterior lower third of body whorl; spire moderately elevated, pointed and consisting of four and one-half whorls; aperture wide, white within, about three-fourths total length of shell, slightly constricted at anterior end; outer lip heavy, flaring at shoulder and reflected outward with a sharp outer edge, spotted with 10–15 grey dashes, finely dentate within, with one large tooth near posterior end; four oblique folds on anterior half of columella; small white callus pad high on parietal wall.

Dimension of Holotype. Length 18·8 mm., width 10·6 mm., length of aperture 14 mm. (Fig. 1).

Animal. Not seen, the collector stated it to be grey and white in colour.

Type Locality and Range. Baia Dos Elephantes 83 miles south of Lobito, Angola, West Africa, trawled in 15 fathoms with coral rubble; a fourth shell, paratype 2 was found dead on the beach at Luanda, Angola.

Discussion. Marginella huberti is quite distinct from other West African *Marginellidae*, but comparable to *Marginella helmatina* Rang, 1832, as figured by Reeve 1864, Pl. 3, Fig. 7 and 7a, in general colour pattern. It differs in having a higher more pointed spire, smaller size and more widely flared aperture. The white tooth on inside of outer lip of *M. huberti* is most unusual and not often seen in species of *Marginella*. The wider placement of its two dark colour bands on body whorl are the most distinctive differences from *M. helmatina*.

Basis of Name. I name this shell for the collector Royce Hubert who in the past ten years, travelling around the world on board his yacht *Sari Marais*, has collected and dredged many species of *Marginellidae* for my studies of this family.

Deposition of Types. Holotype in Manchester Museum, Reg. No. EE3659; Paratype 2 in British Museum (Natural History), Reg. No. 19728; Paratype 1 and juvenile specimen in the author's collection, Rota Cadiz, Spain.

Dimensions of Other Shells. Paratype 1, length 18·2 mm., width 11 mm., length of aperture 14 mm. (Fig. 2). Paratype 2, length 17·9 mm., width 11·2 mm., length of aperture 14 mm. Juvenile specimen, length 17·5 mm., width 10 mm., length of aperture 13·5 mm.

Persicula canaryensis sp. nov. Figs. 3, 4, 5

Description of Holotype. Shell medium sized, elongate-ovate; pattern of orange and white colour composed of small oblong dots that form 20–30 wavy spiral bands around the body whorl, with two bands more prominent and darker in colour, forming two parallel lines (equally spaced apart) on body whorl; spire depressed and just visible, of four whorls (the last one occupies the whole height of the shell); aperture narrow, extending almost full length of the shell, quite flared anteriorly, flesh colour within; outer lip thickened, curved in toward base, reflected and smooth externally, lirate within, white with two evenly spaced orange bands (connecting from the parallel lines on the body whorl); columella with seven widely spaced folds visible, upper ones almost obsolete.

Dimension of Holotype. Length 20·3 mm., width 11·8 mm., (Fig. 3). Paratype 1, length 19·8 mm., width 11·5 mm. (Fig. 4). Paratype 2, length 18·6 mm., width 11·0 mm. (Fig. 5). Paratype 3, length 18·0 mm., width 10·9 mm. Paratype 4, length 17·9 mm., width 10·4 mm. Paratype 5, length 16·5 mm., width 9·8 mm.

Type Locality and Range. Trawled by Spanish fishing boats in 30–60 fathoms off Tarfaya, Morocco, to areas around Fuerteventura in the Canary Islands. Known from six freshly dead and fourteen worn specimens.

Discussion. Persicula canaryensis is unlike any other known species of *Persicula* in colour pattern and only comes close to the shape of small specimens of *Persicula cornea* Lamarck, 1822, as figured by Reeve 1864, Pl. 12, Fig. 52a and b, also trawled in deep water.

Basis of Name. Named for the islands it was found near.

Deposition of Types. Holotype in Manchester Museum, Reg. No. EE3660; Paratype 1 in British Museum (Natural History), Reg. No. 19729; Paratype 3 and 5 to Museum d'Histoire naturelle, Paris; Paratype 2 and 4 in the author's collection Rota Cadiz, Spain.

Reference cited. Reeve, L. A. 1864–1865 *Conchologia iconica*: or *illustrations of molluscous animals 15* (Monograph of the genus *Marginella*): Pls. 1–27.

J. Conch. **27**: 505–508 (1972)

A RECORD OF SLUG MOVEMENTS IN LATE SUMMER

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(*Read before the Society* 18 *October* 1969)

INTRODUCTION

In a restricted area, and using time lapse cine equipment, Newell (1966) has found that *Agriolimax reticulatus* (Müller) often returns to the same hole in the soil from which it has emerged. This could support the work of South (1965) which suggests that well grown *Agriolimax* disperse little, and thus a home range may be established. Taylor (1894–1914) referred to isolated examples of homing in *Helix aspersa* Müller, *Cepaea nemoralis* (L.), *Limax flavus* L., and *L. maximus* L., but the subject has not been studied thoroughly for any of these species.

NIGHT ACTIVITY

The question of homing in slugs needs to be considered against a background of their movement during the night and as day breaks. Frandsen (1901) has described the circuitous movements often made by the slug *Limax maximus*. The records of Newell mentioned above show that *Agriolimax reticulatus* also seldom moves far in a straight line and that circuitous movements are common.

The present paper provides evidence from laboratory experiments and field observations which augments these records. In the field, *Agriolimax* was allowed to move over a black plastic sheet during the night. The sheet was previously sprinkled with white kaolin powder which was moistened by a fine spray of water. Hence, as the slug moved it left a good trace of the route it had taken (Fig. 1). A period of no moon was chosen for the observations.

The same equipment was used to obtain traces between the last hour of darkness and daybreak, and one of these is shown in Fig. 2. A dark screen 90 cm. high had been erected on the east side of the plastic sheet. Here it is seen that the circuitous movement ceased and movement was directed to finding shelter from light by the adoption of an almost straight path to and alongside the screen. It was also noticed that animals suddenly exposed to daylight in the laboratory quickly took a straight course towards shadow or relative darkness.

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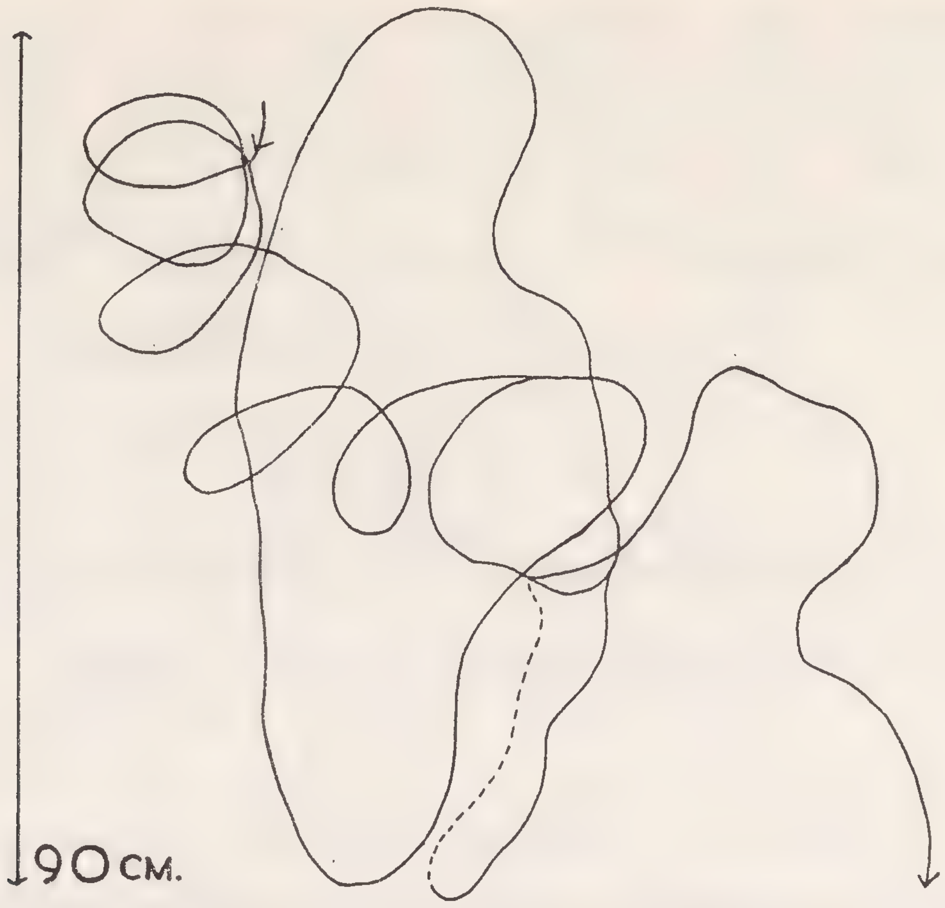

Fig. 1. Route taken during the night 2–3.10.67.

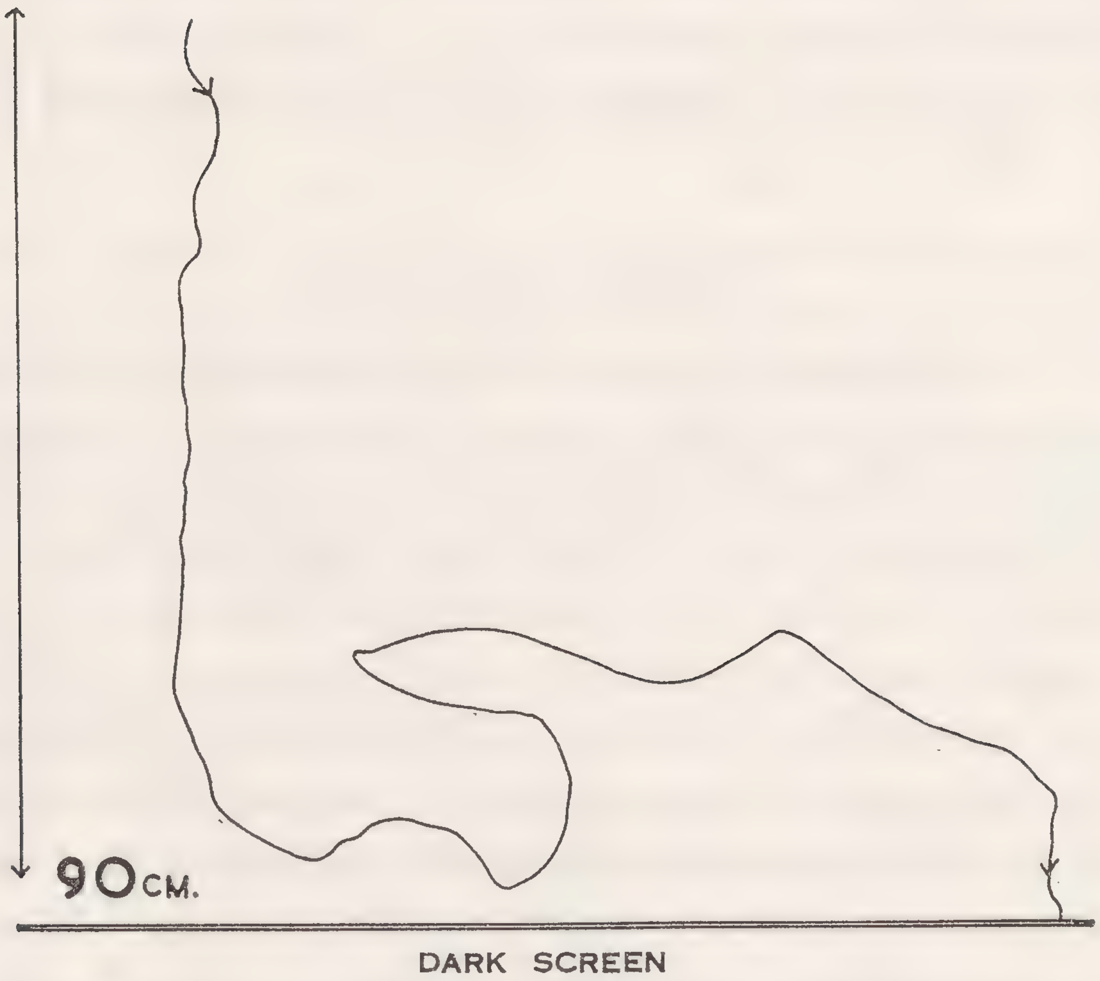

Fig. 2. Route taken between 5.15 a.m. and 7.30 a.m., 14.10.67.

It would therefore appear that the place of rest during the next day must to some extent depend on (a) the position to which the circuitous movements of the animal have led during darkness, which need not be far from the starting point, and (b) on the proximity of the nearest regions of shadow, implying shelter, at daybreak. It follows that a place of daytime rest need not necessarily be the same on consecutive occasions when "competing" shelters are present.

DAYTIME RESTING

It was decided to make a study of slug movements out of doors to see whether slugs return to the same base on consecutive mornings. In this instance it was impracticable to label the slugs with Neutral Red (South, 1965; Hunter, 1968) or radioactive phosphorus (Newell, 1965), as this would have involved disturbing them unduly. However, informative results were obtained by making a sufficiently large number of observations. The species which were found and whose movements were recorded were *Agriolimax reticulatus* (Müller), *Arion hortensis* Férussac, *Milax sowerbyi* (Férussac) and *M. budapestensis* (Hazay). Of these, *Agriolimax reticulatus* was by far the commonest species.

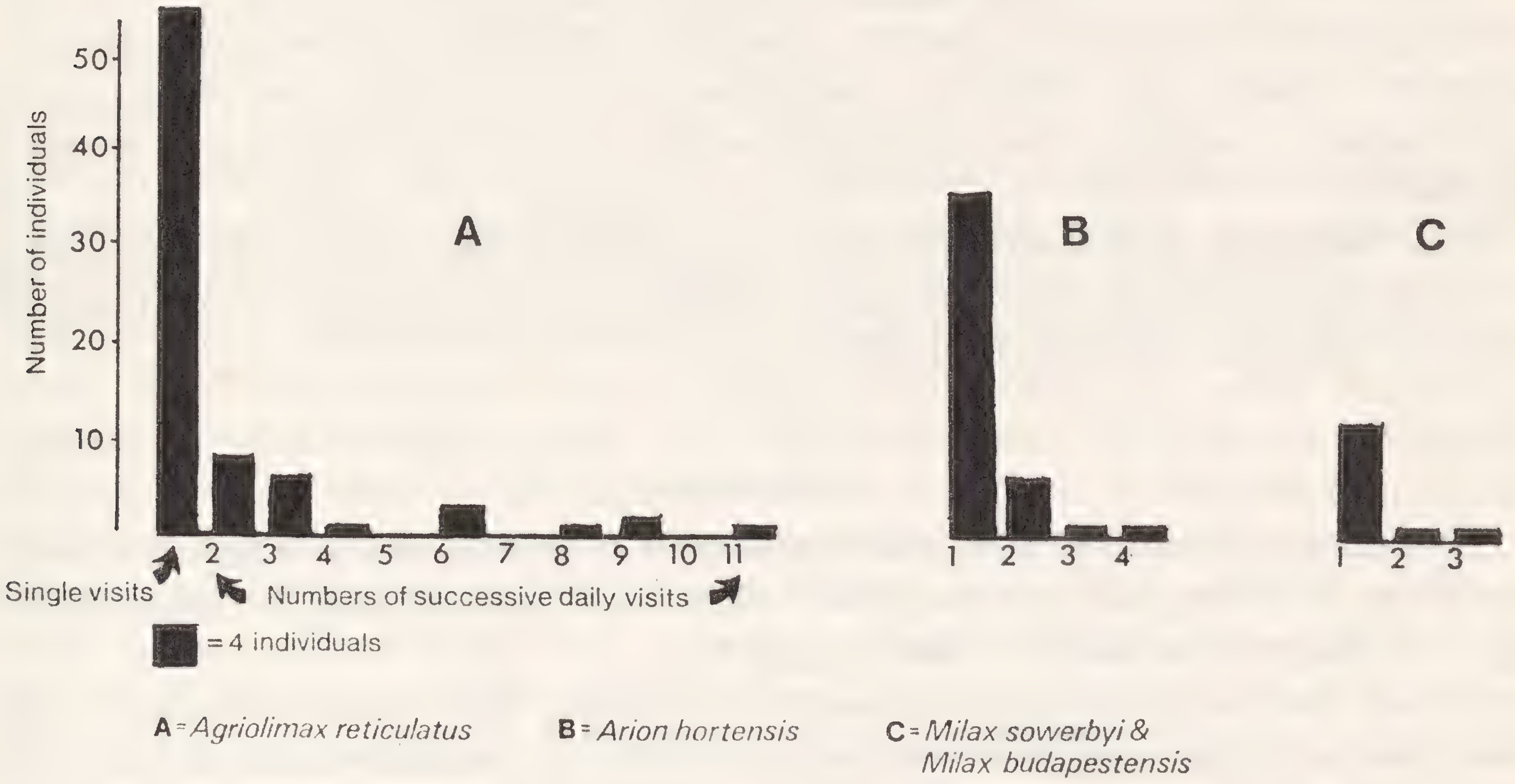

Fig. 3

Seventeen bricks were arranged on the soil surface of a garden in Hertfordshire. They were examined at day break every day for 4 weeks and any slugs resting underneath were noted. The periods when the observations were begun (mid-August) was one of unsettled weather with showers of rain and consequently dews were heavy. A histogram (Fig. 3) has been compiled from these records showing the number of single and consecutive days when slugs were found under particular bricks. Obviously, in the absence of a labelling system, one cannot be sure that all the apparently consecutive visits were made by the same slug, and it must be supposed that an unknown proportion of these visits were not consecutive. Furthermore, in an unknown number of cases the same resting place for consecutive days may have been used because no excursion was made on some nights. It is known (Arias and Crowell, 1963) that slugs can spend several weeks without food and remain alive. Bearing these factors in mind, the histograms show that the minimum number of single visits made by *Agriolimax reticultatus* is between 60% and 70%.

CONCLUSIONS

During nocturnal random searching *Agriolimax reticulatus* usually takes a circuitous route. This type of movement breaks down at dawn and a more or less straight course to the shelter is adopted. This contradicts the findings of Newell (1966) on two occasions when he made observations in a covered area at dawn, who found increased amount of turning at daybreak.

The second conclusion is that there is constant change of place of daytime rest, rather than the establishment of any permanent home base, although a minority of the population above ground may use the same resting place for several consecutive days.

These records do not preclude the possibility that in dry weather, when holes in the ground are used for shelter, a homing tendency may become more pronounced. Under such conditions underground shelter may be restricted, and in the absence of a film of surface moisture the slugs would tend not to move far for food.

The behaviour described above has a bearing on slug control. In the absence of exact homing, slugs will eventually cover a wider area in search of food, and are therefore more likely to find poison baits.

SUMMARY

Agriolimax reticulatus frequently makes a circuitous track when moving in darkness. At dawn, this circuitous movement tends to cease, and the animal moves towards shelter in a more or less straight line.

In late summer, during four weeks with rainfall, *Agriolimax reticulatus*, *Arion hortensis* and *Milax* spp. have been shown to exhibit no marked homing tendency.

ACKNOWLEDGMENTS

My thanks are given to Dr. P. J. Hunter for his very helpful advice on the presentation of this account. The work was supported by an A.R.C. special grant.

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J. Conch. **27**: 509–515 (1972)

VERTICAL RANGE OF MOLLUSCS ON BEN LAWERS, SCOTLAND

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(*Read before the Society*, 21 *November* 1970)

Little has been published on the vertical distribution of non-marine molluscs of the British Isles. The few published accounts of species existing at comparatively high altitudes have usually been of chance discoveries by naturalists whose interests at the time were being directed elsewhere (usually the discoverers were looking for plants). The abundance of such information available for some European countries affords a striking contrast : the work of Mermod (1930) on the gastropods of Switzerland, for instance, is characterised by its wealth of altitudinal information. There are no mountain ranges in the British Isles comparable in height or extent to the Swiss Alps and this factor, among others, has probably inhibited interest in the molluscs which may or may not exist on British mountains.

W. D. Roebuck was sufficiently interested in the subject to climb Buckden Pike, a 2,302-feet mountain in Yorkshire, and to record the various altitudes at which each species occurred (Roebuck, 1889). His work, admittedly frugal in results, went unnoticed. The presence of slugs at or above 3,000 feet in the British Isles has been noticed often, but there are few records of land snails at such altitudes; the paucity of records of fresh-water molluscs is due, of course, to the lack of suitable habitats above 3,000 feet. Of the few species known to have been found at that height or above, about 50% had been discovered on Ben Lawers in mid Perth, Scotland. Consequently, a field trip to Ben Lawers was organised, three full days being spent there in hunting for molluscs 22–24 September 1970.

Rising to a height of 3,984 feet the summit of Ben Lawers is the culminating point of the mountain range on the north side of Loch Tay. The range is part of the Breadalbane region of the Central Highlands which includes several summits approaching 4,000 feet. Ben Lawers, long famous for its many species of arctic-alpine plants, is known to support a varied and interesting vertebrate fauna (Roger, 1964). Its invertebrates, however, are poorly known, and some other parts of the Breadalbane region, for instance the nearby Tarmachans, have been better studied in this respect. It would be surprising if the fauna and flora of Ben Lawers were not unusual because there is little accumulation of peat above

2,000 feet, and above that altitude the mountain is composed mainly of mica schist rich in the minerals required by plants and animals. The rarer plants flourish above 3,000 feet, mostly in places inaccessible to sheep, and it is reasonable to assume that molluscs could survive there too. It can now be shown that several species do have a precarious footing on Ben Lawers up to 3,900 feet.

Several naturalists have noticed molluscs at various altitudes on Ben Lawers. Nearly a century ago F. Buchanan White recorded *Clausilia bidentata* (Ström) at 2,400 feet, and *Lehmannia marginata* (Müller) at 3,000 feet (White, 1873). F. F. Laidlaw recorded *Arianta arbustorum* (L.) and *Clausilia bidentata* at 3,000 feet, and at about 3,800 feet the fragile "dead shells" of a species of *Vitrina*, "presumably" *V. pellucida* (Müller) (Laidlaw, 1908). A. W. Stelfox (1952) recorded *Arianta arbustorum* at about 3,800 feet; and W. Ramsden found *Columella edentula* (Draparnaud) at 3,350 feet and *Arianta arbustorum* at about 3,200 feet (Jackson, 1948). Finally there is an unpublished record of *Arion subfuscus* (Draparnaud) and *Arion ater* (L.) being found together in July 1963, at about 3,900 feet, by Stelfox (*in litt.* to S.P.D. 26.ix.1970).

On 22 September, in thick mist, and on 24 September, in fine sunny weather, Ben Lawers was climbed by the western approach route (i.e. from the car park at 1,400 feet, via Beinn Ghlas). On 23 September, the Lawers Burn route was followed, the objective being Lochan-nan-Cat (= Lochan a' Chait), a shallow lake at 2,300 feet situated NNE of Ben Lawers; the cliffs above and to the west of the lochan were surveyed briefly as well. The species noticed above 1,000 feet are listed below (Table 1); those collected by others are included also to make the list complete.

COMMENTS ON THE SPECIES LISTED

Lymnaea peregra (Müller): The presence of a high-spired "ovata" form in Lochan-nan-Cat has been noted by Stelfox (1952). As he found a similar but smaller form of the same species at 2,700 feet on a col near Glen Lyon, a few miles to the north-west, its presence in the lochan is not surprising. Many empty shells and numerous living specimens were seen in the eastern half of the lake on 23 September 1970; some of the shells were extremely eroded.

Columella edentula (Draparnaud): A special search for this species at about 3,350 feet was fruitless. It would be interesting to know what form the species takes here as it is otherwise unknown at anything like this altitude in the British Isles.

Clausilia bidentata (Ström): Laidlaw (1908) says that the specimens he found at 3,000 feet were "somewhat dwarfed". This has no significance in an altitudinal context as many lowland specimens could be so described. Few British land pulmonates vary so much in size and relative proportions: in parts of Wales, at any rate, short and fat shells and long slender ones are sometimes found in a single population.

LOCALITY BG Beinn Ghlas BL Ben Lawers LB Lawers Burn	COLLECTOR	DATE	ALTITUDE (in feet)	SPECIES (R = altitude record for British Isles)															
				Lymnaea peregra	*Columella edentula*	*Clausilia bidentata*	*Arianta arbustorum*	*Arion subfuscus*	*Arion ater*	*Arion intermedius*	*Euconulus fulvus*	*Retinella radiatula*	*Retinella pura*	*Vitrina pellucida*	*Lehmannia marginata*	*Agriolimax reticulatus*	*Pisidium casertanum*	*Pisidium lilljeborgii*	*Pisidium nitidum*
LB	S.P. Dance	ix.1970	1,050									*							
,,	,,	,,	1,100	*															
,,	,,	,,	1,300						*						*	*			
,,	,,	,,	1,400						*			*			*	*			
Car park west of BG	,,	,,	,,													*			
West of BG	,,	,,	1,700					*							*				
LB	,,	,,	1,750					*							*	*			
,,	,,	,,	2,000													*			
BG	,,	,,	2,050					*											
,,	,,	,,	2,300					*	*										
Lochan-nan-Cat	,,	,,	,,	*													*	*R	*
BL	F. B. White	1873	2,400			*													
North-east slope of BL	S.P. Dance	ix.1970	2,450						*			*							
,,	,,	,,	2,500					*	*		*R		*R						
,,	,,	,,	2,550											*					
BL	F. B. White	1873	3,000												*				
,,	F. F. Laidlaw	1907	,,			*R	*												
North face of BG	S.P. Dance	ix.1970	3,050					*											
,,	,,	,,	3,100							*				*	*				
BL	W. Ramsden	vii.1944	3,200				*												
North face of BG	S.P. Dance	ix.1970	3,250					*											
Pool on col between BG and BL	,,	,,	3,300														*R		
BL	,,	,,	,,					*						*	*				
,,	W. Ramsden	vii.1947	3,350		*R														
,,	S. P. Dance	ix.1970	,,												*				
,,	,,	,,	3,400					*						*	*				
,,	,,	,,	3,500				*	*						*					
,,	,,	,,	3,550												*				
,,	,,	,,	3,700											*					
,,	A. W. Stelfox	vi.1947	3,800				*R												
,,	F. F. Laidlaw	1907	,,											*R					
,,	A. W. Stelfox	vii.1963	3,900					*R	*R										
,,	S. P. Dance	ix.1970	,,												*R				

Arianta arbustorum (L.): This is apparently scarce in the area below 2,500 feet but it may be incorrect to assume that it is significantly commoner above that height on the basis of present knowledge. One broken shell was all that rewarded the writer's three-day search for it on Ben Lawers and Beinn Ghlas. Like the living specimen recorded by Stelfox at 3,800 feet it measures only 15 mm. in maximum diameter although the lip is well formed; it is noteworthy for its fragility, and its spire is sufficiently elevated (maximum height 14 mm.) to qualify as an example of the "var. *alpicola* Férussac" (= var. *alpestris* Rossmässler). A characteristic form of montane areas in Europe its presence at high levels on Ben Lawers may or may not be significant. It is frequently found in lowland parts of the British Isles, and it is the prevalent form, for instance, on blown sand at Strathy on the coast of West Sutherland, Scotland (Cain, Cameron and Parkin, 1969).

Arion subfuscus (Draparnaud): This is one of the three species which form the "core" of the Ben Lawers molluscan fauna (the other two being *Vitrina pellucida* and *Lehmannia marginata*). The several records between 1,700 and 3,900 feet indicate that it may be as successful and as hardy a mountain colonist as *Arion ater* and *L. marginata* (although it is rare to find more than two congregated together, unlike *L. marginata* which does not seem to be a lone wanderer by choice). Montane populations of *A. subfuscus* may be widespread in the British Isles. The species has been found at 3,018 feet in the Galtee Mountains, Co. Sligo, Ireland (A. W. Stelfox leg.) and at 3,200 feet on the north face of Snowdon, Wales (S. P. Dance leg.); the highest altitude for it in England seems to be 1,240 feet near Malham Tarn, Yorkshire (L. W. Stratton leg.). A feature of Ben Lawers specimens in dorsal view is their very dark brown coloration. In view of recent research on other species of *Arion* in the British Isles it may be worth while collecting fresh specimens of this dark-brown form to obtain satisfactory evidence of its real identity. The writer too hastily assumed that it was *A. subfuscus* and did not retain any specimens for dissection.

Arion ater (L.): Perhaps the most familar mollusc on British mountains it was scarce at all levels on Ben Lawers in September 1970 although conditions were obviously favourable for slugs.

Arion intermedius Normand: A single specimen was found at 3,100 feet on Beinn Ghlas. Its dorsum was yellow and its foot-sole bright orange and in these respects closely resembles the colour form found by Stelfox and R. Welch at 2,700 feet on Brandon Mountain, South Kerry, Ireland (Stelfox, 1911 : 83), and that found by the writer at 3,150 feet on the north face of Snowdon, Wales. Perhaps this species is not so tolerant of adverse conditions as the other slugs. As it was found in humus amongst huge boulders on a sheltered slope it may require more adequate protection than is available over most of the area.

Euconulus fulvus (Müller): This and the next two species were found on the dripping wet cliffs forming the north-east rampart of the north corrie of Ben Lawers. The single specimen was very fragile. It has been found at 2,250 feet in the Black Mountains of Brecon and Monmouth, Wales (S. P. Dance leg.).

Retinella radiatula (Alder): A single specimen only. It has been found at 2,900 feet on the north face of Snowdon, Wales (S. P. Dance leg.).

Retinella pura (Alder): A single specimen was found living with *Euconulus fulvus*. The shell was so fragile that it was partially crushed even with gentle handling.

Vitrina pellucida (Müller): The characteristic shelled mollusc of Ben Lawers. It has not been found below 2,550 feet on the mountain, but it is a common snail at about 400 feet in gardens at Killin at the western end of Loch Tay. Several specimens were found depositing eggs on 24 September 1970 in humus on a cliff ledge at 3,500 feet. The animals were very darkly pigmented, more black than grey, but upon dissection (by Dr. L. Lloyd-Evans) they were identified as typical *V. pellucida*. The positive identification of *V. pellucida* up to 3,700 feet indicates that the poorly preserved shells found by Laidlaw at 3,800 feet belonged to the same species. It has been found at 3,150 feet on the north face of Snowdon, Wales (S. P. Dance leg.).

Lehmannia marginata (Müller): The most abundant slug on Ben Lawers. Specimens from above 3,000 feet were very darkly pigmented, greyish-black in colour, which gives them a very different appearance to lowland specimens. Elsewhere this has led to misidentifications. Stelfox (1911 : 75) recorded, as *Milax gagates* (Draparnaud), an almost black slug at 3,127 feet on the summit of Brandon Mountain, South Kerry, but it was really *L. marginata* (Stelfox, personal communication to S.P.D., 1957). More recently the writer recorded, as *Limax cinereoniger* Wolf, a similar specimen of *L. marginata* from Cwm Cau, at about 1,500 feet on Cader Idris, Merioneth (Dance, 1970: 166). Of the 12 land pulmonates recorded from Ben Lawers *L. marginata* may fairly claim to be the most successful. It has been found at 3,450 feet near the summit of Snowdon, Wales (S. P. Dance, leg.).

Agriolimax reticulatus (Müller): This was the most abundant slug species along the banks of the Lawers Burn but was not found above 2,000 feet. It has not been found at a greater altitude in Scotland but lives at 2,550 feet in the Brecon Beacons, Wales (S. P. Dance leg.).

Pisidium casertanum (Poli): Specimens from the pool at 3,300 feet are rounded and rather swollen at the umbones. One contained 7 embryos. As the pool is only about 6 inches deep it is almost certainly frozen solid during part of the winter. The next highest altitude recorded for the species in the British Isles is 2,400 feet (Ffynnon Felen in Cwm Glas, Snowdon range, Wales) (C. Oldham leg.).

Pisidium lilljeborgii Clessin: Lochan-nan-Cat is the locality from which Laidlaw collected some of the first specimens of this species to be authenticated for the British Isles (Woodward, 1913: 107, 115). It is fairly common there at the eastern end near the outlet.

Pisidium nitidum Jenyns: Only 4 specimens were found in Lochan-nan-Cat but the species is predominantly a lowland dweller, previously unknown above 2,000 feet in the British Isles, but since found at 2,350 feet in Llyn-y-Cwn, near Cwm Idwal in Snowdonia, Wales (S. P. Dance leg.).

DISCUSSION

This survey had limited and simple objectives: (1) to find out which molluscan species live on the upper slopes of Ben Lawers; (2) to find out the maximum altitude attained by those species; (3) to see if there were any obvious morphological features, either of the shells or their contained animals, which could be associated with conditions imposed by a montane environment; (4) to acquire records of species existing at altitudes in excess of the maximum altitudes attainable on any mountain in Wales—the summit of the Snowdon massif is 3,560 feet—where the writer is studying vertical distribution of molluscs in detail. Consequently it is unwise to try to explain the presence of any of the species recorded and their frequency; that should only be attempted when additional data on other mountain-dwelling molluscs is available. Morphological features which seem to be associated with this montane environment include the apparently melanistic colouring of *Arion subfuscus*, *Vitrina pellucida* and *Lehmannia marginata* (*Arion ater* is usually black, and the black footsole characteristic of the form *aterrima* Taylor, the prevalent colour form on Ben Lawers, is sometimes encountered in lowland localities in the British Isles). The fragility of the shells of *Arianta arbustorum*, *Euconulus fulvus* and *Retinella pura* was noteworthy, but only because one may have expected thicker shells to be produced by animals living on or in moderately calcareous substrates. Soil tests carried out on Ben Lawers at 3,300 and 3,400 feet each gave readings of pH 7·5 (strongly alkaline), and at 3,100 feet on Beinn Ghlas a reading of 6·5 (weakly alkaline). Given a longer snow-free period (snow cover may persist for as long as 9 months on the higher Breadalbane summits) it is possible that *Arianta arbustorum*, for instance, would develop a thicker shell.

Some species which are known to exist at high altitudes elsewhere in the British Isles were conspicuously absent. *Discus rotundatus* (Müller) and *Oxychilus alliarius* (Miller), well known colonisers of montane habitats, were confidently expected to turn up on Ben Lawers as both have been found, together with *Cepaea hortensis* (Müller), at 3,050 feet on Ben Laoigh in mid Perth (Hunter and Hunter, 1956); on the same mountain, at 3,000 feet, J. C. Melvill found the "var. *alpicola* Férussac" of *Arianta arbustorum* (Taylor, 1914: 436). The Tarmachans, a mountain group west of but adjacent to the Ben Lawers group, could prove to be more productive although the highest peak is about 500 feet lower than Ben Lawers. *Vitrea crystallina* (Müller) has been found at Craig-na-Caillich, at about 2,500 feet (Stelfox, 1952); and *Hygromia hispida* (L.) has been found on the Creag an Lochan cliff at 2,150 feet (M. Smith leg. 1963). (The complete list of Mr. Smith's discoveries in the Meall nan Tarmachan National Nature Reserve is worth recording here: *Lymnaea peregra*, Lochan Tairbh Uisge (2,500 feet); *Clausilia bidentata*, *Discus rotundatus*, *Oxychilus alliarius*, *Retinella radiatula*, north end of Creag an Lochan cliff (2,050 feet); *Arianta arbustorum*, centre section of Creag an Lochan cliff (2,250 feet); *Cepaea nemoralis* (L.), above the dam (1,750 feet), *Hygromia hispida*, north end of

Creag an Lochan cliff (2,150 feet); *Euconulus fulvus*, *Vitrea crystallina*, *Vitrina pellucida*, near outflow of Lochan Tairbh Uisge (2,450 feet). All these were found in July 1963.)

As the writer concentrated his efforts on that part of Ben Lawers above 3,300 feet it is highly probable that other species await discovery on and around Ben Lawers above 2,000 feet, particularly on the north-east slope of the north corrie at about 2,500 feet where conditions seem to be more favourable for molluscs than elsewhere on the mountain. This is not the place to discuss aspects of vertical distribution in the wider sense, especially by comparison with data from western Europe. That may be discussed in a later paper when more data from mountains in the British Isles are available. Perhaps enough field work has been carried out in the British Isles in the past to indicate that the higher slopes of Ben Lawers support a richer molluscan fauna than those of any other British mountain of comparable altitude. A total of 16 species are known to live at 3,000 feet or above in the British Isles, 9 having been found on Ben Lawers and 7 having been found on other mountains (from information compiled by the writer and intended for publication). Ben Lawers is unique in providing the only reliable records of molluscs living as high as 3,900 feet in the British Isles.

ACKNOWLEDGMENTS

For allowing me to publish information based on his field work and for his encouragement I am grateful to Mr. A. W. Stelfox. For permission to use unpublished data based on field work in the Meall nan Tarmachan National Nature Reserve I am indebted to Mr. M. Smith of the Nature Conservancy, Edinburgh. Dr. L. Lloyd-Evans kindly confirmed the identity of the Ben Lawers *Vitrina pellucida* by dissection. Mr. P. Langhelt of the Zoology Department, National Museum of Wales, assisted in various ways and proved a cheerful and useful companion during the Ben Lawers excursion.

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REVIEW

Sea Shells of the Texas Coast, by Jean Andrews (The Elma Dill Russell Spencer Foundation Series No. 5). 1 col. plate, photographs of 369 molluscs, 65 line-drawings, 6 maps, pp. xi–xvii, 1–298. University of Texas Press. 1972. Price £8.50.

This book fills a gap in the regional literature of American coastal waters, dealing as it does with the littoral and shallow-water molluscs of the Texan coastline. The author modestly states that it is not intended to be a complete list of the shallow-water Mollusca of Texan waters, but is for use in determining the species to be found there. To this end she carefully describes and illustrates (in Part I, pp. 51–230) more than 300 species. Most of the photographs are excellent, though one wishes that the only loricate included had been illustrated by enlarged figures of the separated valves instead of a photograph of the whole shell. In the Teredinidae, however, the pallets, essential for identification, are all figured (ex Turner, 1966).

Texas owns some 624 miles of beach (if bays and intertidal flats are included), and a chain of barrier-islands described as the longest in the world. A variety of habitat is present, and in Part II of the book Miss Andrews describes in detail and with the aid of six good maps how they can be reached by car (a 4-wheel drive is essential). Instructions are given for preparing molluscs for the collection, the care of the collection, etc. etc. There are even 2 pages of recipes for cooking molluscs! The last section "Beachcombing" seems rather out of place in a book of this kind; it describes and illustrates some of the many oddments one finds cast-up, including a long list of non-marine shells so obtained (ex Pilsbry and Hubrecht, 1956).

Taken as a whole the work is a very useful addition to the conchological library as it covers excellently the Mollusca of an area as yet imperfectly known. It is especially valuable for its fine figures of very many minute species not dealt with in either Abbott's *American Seashells* (1958) or Warmke and Abbott's *Caribbean Seashells* (1961).

The book is beautifully produced and the cost not exorbitant by current standards. It is warmly recommended.

NORA F. MCMILLAN

J. Conch. 27: 517–518 (1972)

LAURIA SEMPRONII (CHARPENTIER) LIVING IN BRITAIN

M. P. Kerney

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A. Norris

City Museum, Leeds 1

(*Read before the Society* 18 *March* 1972)

Lauria sempronii (Charpentier) is an alpine and south European species which has been recorded fossil from three Postglacial deposits in south-east England Kerney, 1957). None of these is earlier than the Neolithic period, and it seemed possible that the species might continue to live in this country.

One of us (A.N.) recently detected in the Leeds Museum fourteen examples of *Lauria sempronii* in the collection of A. G. Stubbs (1871–1950). They are labelled "*Vertigo edentula.* Haresfield Beacon nr Glo'ster. A.G.S. 1894". Under this erroneous name they were exhibited with other Gloucestershire shells at a meeting of the Conchological Society in Leeds on 26 September 1894 (*J. Conch.* 7 : 429) (Stubbs was then living at 9 Park View, Gloucester). The specimens were obviously taken live, and some still contain the dried remains of the soft parts. All are of the edentate form (= var. *dilucida* Rossmässler), as are the fossil shells from south-east England (Kerney, 1957, figures 1–4).

Haresfield Beacon is a prominent viewpoint at 713 ft. O.D. on the limestone escarpment of the Cotswold Hills about 3 miles north-west of Stroud (32(SO)820088). On 20 November 1971 Mr. S. P. Dance visited the locality and on the following 5 December a party of eight also made a search, but on neither occasion was *Lauria sempronii* found. The ground surrounding the Beacon offers a variety of habitats, including limestone grassland, stone walls, rock screes, and deciduous woodland. The molluscan fauna is rich, 44 species being noted on our visit of 5 December. Perhaps the most interesting of these was *Vitrina major* (Férussac) found living on a stone wall under beech trees at 827088. Further search of the area is clearly needed. *L. sempronii* lives abroad in similar habitats to *L. cylindracea* (da Costa), such as woods, rocks and old walls. It is reported as liking rather damper situations than that species (Mermod, 1930). The other species in the Stubbs collection at Leeds taken at Haresfield Beacon in 1894 suggest a rocky place (*Pyramidula rupestris* (Draparnaud), *Balea perversa* (Linné), *Helicella caperata* (Montagu)), but only the ubiquitous *L. cylindracea* could be found in such habitats in 1971.

A search through the collections of British *Columella* and *Lauria* in the British Museum (Natural History) revealed no further examples of *L. sempronii*. The species is therefore likely to be a rare one in Britain, and not merely overlooked.

REFERENCES

KERNEY, M. P., 1957. *Lauria sempronii* (Charpentier) in the British Holocene. *J. Conch.* **24**, 183–191.
MERMOD, G., 1930. *Catalogue des invertébrés de la Suisse*, **18**, Gastéropodes. Mus. Hist. Nat. Geneva.

REVIEW

How to Know the American Marine Shells by R. Tucker Abbott (new and revised edition). A Signal Reference: New American Library Times Mirror 1971. Paperback. 222 pp. 12 col. pls. and numerous text-figs. Price $1.25.

Dr. Abbott has the gift of presenting much information in a concise form and this work, designed for the beginner, will be found a most useful aide to any collector. More than 400 of the commoner spp. are described and very many figured. There are general hints on collecting, identifying and exchanging shells, as well as how to organise and run a shell club. A novel feature is an appendix of the common spp. most likely to be found in each of the 22 geographical areas listed, from Alaska to southern California and Prince Edward Island to Florida. A digest of shellfishery laws presents entertaining reading; we learn that in California a sport fishing licence is necessary for any person of 16 years or over for the taking of *any mollusks*; in Alaska a sportsmen's licence is needed when hunting razor-clams (*Siliqua*); in Washington the enormous Geoduck (*Panope*) may only be dug in June, July and August, and is is unlawful to thrust a stick through or to possess such maimed Geoducks. Massachusetts regulations are (to quote Dr. Abbott) "complicated, scientifically inaccurate and ambiguous, e.g. "Whoever catches starfish, winkles and their egg strings, or cockles shall deposit the same at some place above high water mark . . .". In some states it is illegal to take any mollusks on Sundays.

We may, perhaps, be thankful that in Britain the shell-collector can still pursue his hobby in relative freedom.

N. F. McMillan

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J. Conch. 27: 520–533 (1972)

OBITUARY

ARTHUR WILSON STELFOX, 1883–1972

Arthur Wilson Stelfox was born in Belfast, Northern Ireland, on 15 December 1883, youngest child of James Stelfox (of Cheshire descent) and his wife Jennie McIlwaine, daughter of Canon McIlwaine, Rector of St. George's, Belfast.

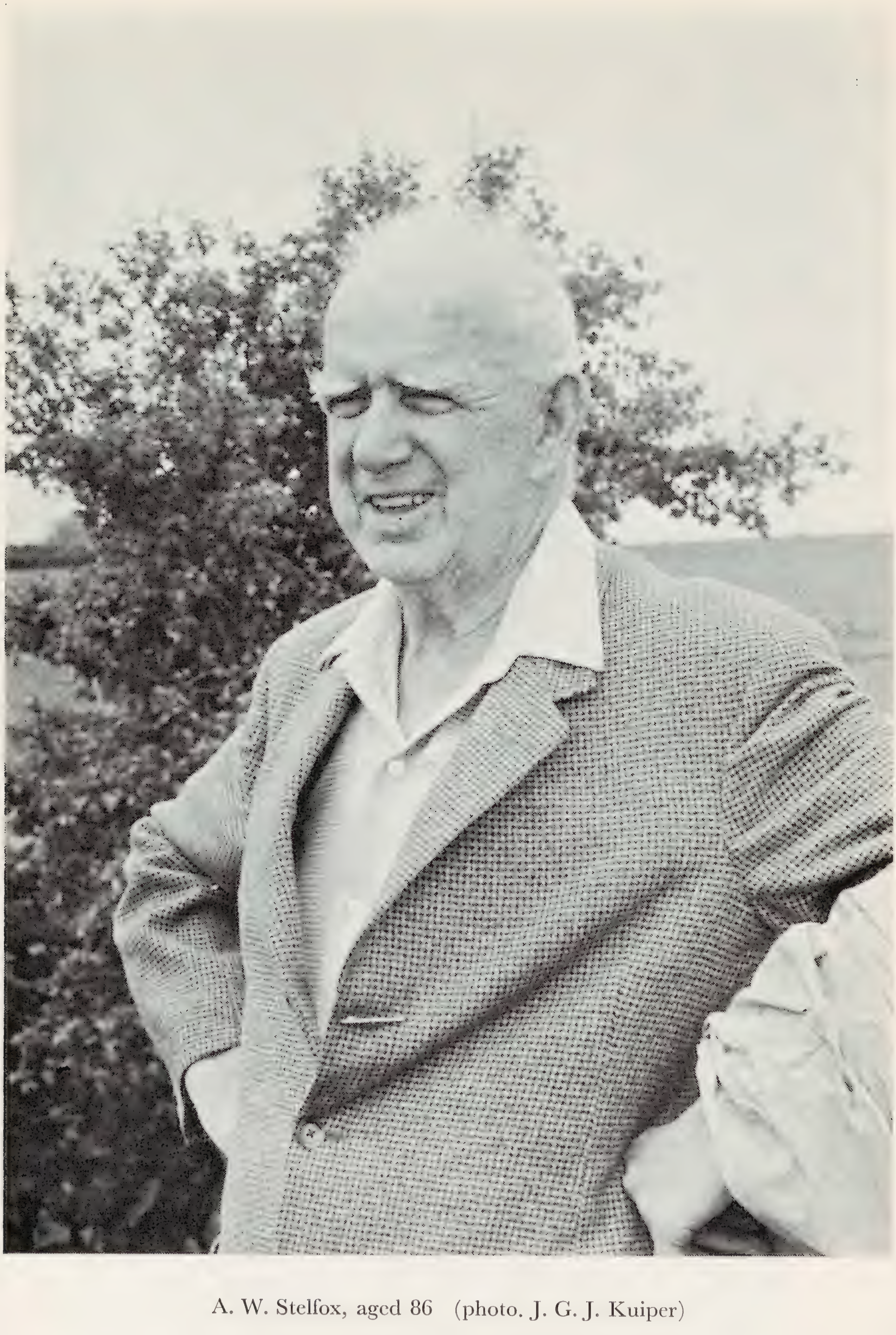
From boyhood Stelfox was a naturalist; he once told me that he could not remember a time when he was not interested in wild nature, although he had no time for domesticated plants or animals. In his youth, unfortunately, there was very little chance of a living being made in natural history, and he therefore qualified as an architect. But his heart was never in it, and when in 1920 he had the opportunity of obtaining a post in the National Museum of Ireland he took it, and moved to Dublin. Here he began work on the Hymenoptera and also on cave-bones on both of which subjects he became a recognised authority. His fine private collection of Hymenoptera (mostly Irish), numbering some 90,000 specimens, was given to the Smithsonian Institution (Washington, U.S.A.) in 1966.

In the National Museum his room was the centre for all naturalists, whatever their particular discipline, until his retirement under the age limit in 1948. For many years the museum was seriously understaffed and Stelfox and his technical assistant Eugene O'Mahony had to cope with the whole field of zoology.

His interest in the Mollusca dated from his earliest days; in his collection (now in the Liverpool Museums) there are specimens labelled "Kenmare 1898", taken on his first big field-trip, the Irish Field Clubs Union field-meeting at Kenmare, Co. Kerry, when he was just a schoolboy. During his three years in London (1906–1908) every weekend was spent snail-hunting and his journals for this period are full of interest. He was the first to recognise *Helicella heripensis* Mabille (now *H. gigaxii* L. Pfeiffer)—in 1912, and in the face of opposition from A. S. Kennard who dismissed it as merely a variety of *H. caperata*, and was also the first to recognise *Pisidium pseudosphaerium* as "something different" although he could never get a name for it.

After his return to Belfast he became an active member of the Belfast Naturalists' Field Club and founded the now-thriving Junior Section in 1911. Of this he was very proud, and indeed throughout his long life he gave unstintingly of his time to helping beginners of all ages.

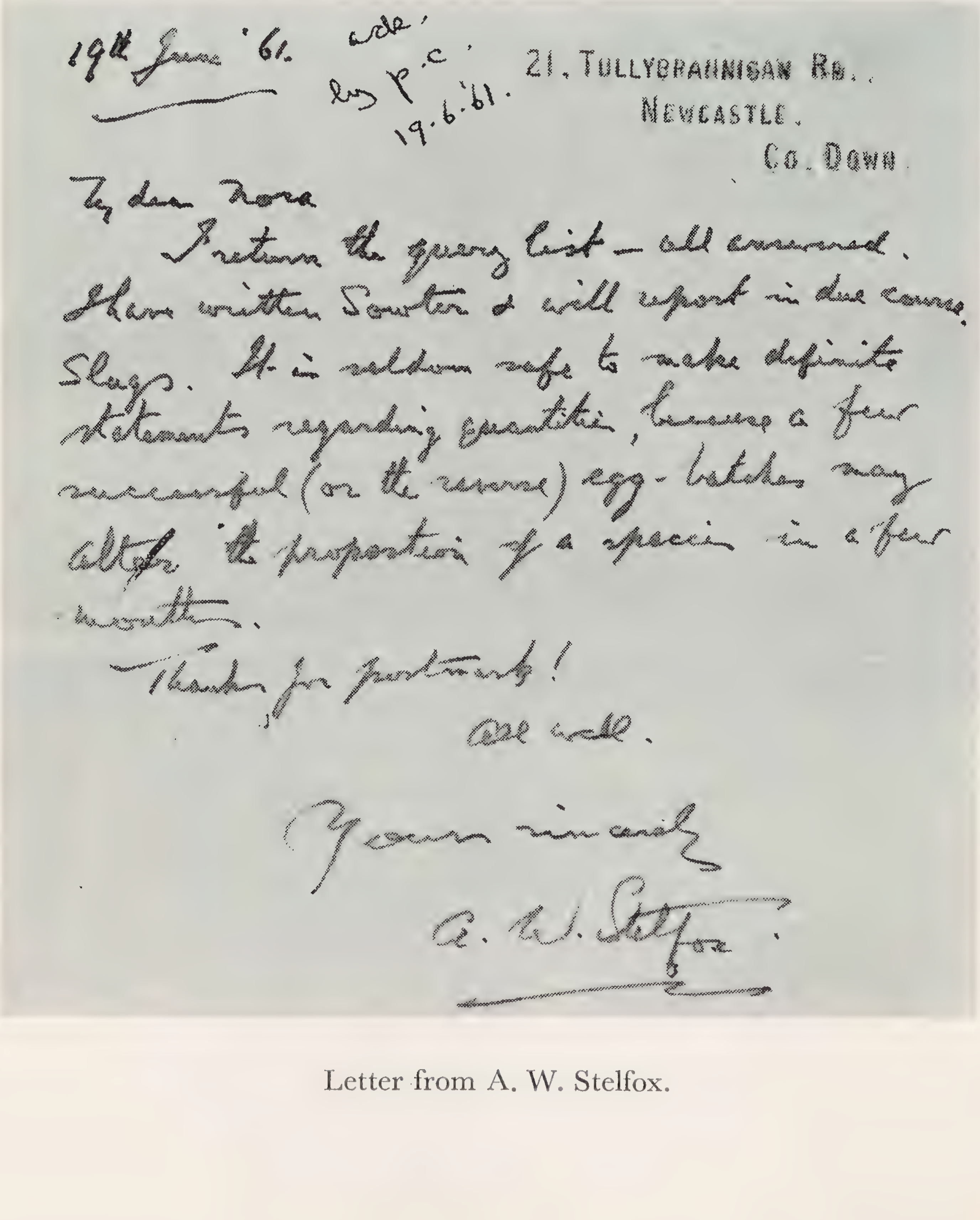
It was about this time when he was taking part in the Royal Irish Academy's Clare Island Survey that his interest in the genus *Pisidium* began. All the Clare Island material had been submitted to B. B. Woodward for naming, but Woodward's determinations puzzled Stelfox, and a little later he and his friends Charles Oldham and R. A. Phillips decided to start a "beginners class" in the genus



A. W. Stelfox, aged 86 (photo. J. G. J. Kuiper)

Plate XXI

A. W. Stelfox collecting, 1910.



19th June '61.

ack'd by p.c. 19.6.61.

21, TULLYBRANNIGAN RD.,
NEWCASTLE.
CO. DOWN.

My dear Nora

I return the query list — all answered. I have written Sowter & will report in due course. Slugs. It is seldom safe to make definite statements regarding quantities, because a few successful (or the reverse) egg-batches may alter the proportion of a species in a few months.

Thanks for postmark!

All well.

Yours sincerely

A. W. Stelfox.

Letter from A. W. Stelfox.

Pisidium. The trio struggled on for some years, seldom meeting but regularly exchanging material, comments and criticisms; eventually order emerged out of chaos and the species are now well understood. In this difficult group his fine critical eye proved its worth; his findings have stood the test of time.

In 1951 he gave his fine collection of *Pisidium* spp. to the Rev. H. B. Herrington of Ontario, Canada, who in turn passed it on to the Museum of Zoology, University of Michigan. About a hundred sets of material, however, mostly from Lancashire and Cheshire localities, determined by Stelfox, Oldham and Phillips, and accompanied by full notes on the identifications, came to Liverpool Museums in 1936 with Dr. J. W. Jackson's collection of non-marine Mollusca.

During this period he and his lifelong friend Robert Welch did some pioneer work on the Mollusca of a marl-deposit underlying a bog near Killough, Co. Down. Marl-samples taken near the margin yielded an Arctic fauna including the very rare *Pisidium vincentianum* B. B. Woodward, but the full results of the work were never written up for publication. Stelfox always wished to see an account of the White Bog and its molluscan fauna in print, and was much pleased when in June 1970 it was arranged with Prof. G. F. Mitchell, Mr. J. G. J. Kuiper and N.F.McM. to visit the bog. Stelfox, despite his 86 years, took an active part in the proceedings and the accompanying portrait is from a photograph taken by Kuiper on that occasion. It is good to know that the White Bog paper, accepted by the Royal Irish Academy, was seen in proof by Stelfox.

In 1956 the Stelfoxes moved from Dublin to Newcastle, Co. Down, where they laid out unaided a charming garden at the foot of the Mournes. Here he lived happily, visited by innumerable scientific workers. His house was a landmark for the lovely garden, and visitors were told how to find him "Walk up towards Slieve Donard and look for the house with the pansies on the drive!" (motorists had to proceed with care on the Stelfox drive).

He had a wonderful knowledge of the Irish flora, and took a special delight in mountain plants. Many of them now grow in his remarkable garden at No. 21, Tullybrannigan Road, a kind of private botanical garden especially rich in sedges and willows. I well remember visiting personally every willow on a small Orcadian island in search of a willow described by Stelfox as "aluminium-leaved" and his pleasure when at last a silvery-leaved bush was found and cuttings sent to him.

Personal vanity was unknown to him, he was generous to a fault, and nothing mattered but care and accuracy in one's work. He retained his fine critical eye and his deep interest in the natural world about him until his last few weeks. It seems unbelievable that he has gone, that there will be no more letters, that the familiar white-haired figure will no longer be seen in his beloved garden, that the source of so much help and kindness for so many years has gone from us.

He died in hospital on 19 May 1972 after a short illness; his wife (née Margarita Dawson Mitchell) herself a fine naturalist and a graduate of Queen's University, Belfast, predeceased him on 13 August 1971. He leaves a son, a daughter-in-law and two grandchildren as well as a host of friends to mourn him.

His annotated copies of his "Irish List" and the Clare Island Report were given to Dr. M. P. Kerney some time ago, the first three volumes of his journal (which are entirely conchological) he gave to me in 1956. Later volumes of the journal are mostly entomological, with some botany, and these (vols. 4–32) are in the Smithsonian Institution with his entomological collections. The last two volumes of the journal, faithfully kept until the night before his last illness, remain in his son's care.

Nora F. McMillan

Stelfox's greatest contribution to the study of Mollusca was his paper on "The *Pisidium* fauna of the Grand Junction Canal in Herts. and Bucks." (1918) which revolutionised the hitherto very unsatisfactory treatment of the genus and furnished the basis upon which all future specialists on this genus have built. Stelfox recognised the prime importance of the hinge characters in determining the species, and as a consequence he "put *Pisidium* on the map". Although often urged to write a monograph on *Pisidium* or at least a guide, he always declined. He said that the above paper contained all that was necessary (as a matter of fact, it does not deal with *all* the British species), and he had a rooted objection to "guides" which he maintained misled people into wrong identifications. At the same time, when Cyril Diver bludgeoned me into writing my paper on "The identifications of the British species of *Pisidium*" (*Proc. malac. Soc. Lond.* **24**: 44–88, pls. 3–6, 1940), Stelfox generously placed his notes at my disposal. Though he would not permit his name to appear even as joint author, that paper owes far more to A.W.S. than to A.E.E.

The other major contributions Stelfox made to molluscan literature were his "List of the land and freshwater mollusks of Ireland" (1911), a census of the distribution of Irish non-marine Mollusca, and his "Clare Island Survey" report (1912). The latter, an ecological and distributional study of a difficult area in the West of Ireland, was always thought by Stelfox to be his best piece of work, although that on the *Pisidium* fauna of the Grand Junction Canal was undoubtedly the most important.

It is an incalculable loss to conchology that his interest was diverted to entomology.

A. E. Ellis

About 1920 Stelfox, Phillips and Oldham planned to write jointly a monograph on the British species of *Pisidium* which, for various reasons, never materialised. Stelfox wrote a Preface to the projected monograph and some years ago he gave me permission to use this as I wished. As it throws light upon his early struggles with the genus and upon the study of *Pisidium* in general it is here printed just as he left it.

N. F. McMillan

PREFACE TO THE *PISIDIUM* MONOGRAPH

Written by A.W.S. on 26 September 1922

In my schooldays I have vivid recollections of collecting mollusca with men who are mostly now beyond the grave; indeed it has always been my lot to have as my closest friends men who were much older than myself, so as I grew up I was constantly losing their companionship. There are but two exceptions to the age of my friends and it is to one of these—my wife—and to the memory of the other—my little daughter—that I desire to dedicate this MS. To the former I owe gratitude inexpressible for patient encouragement in my work and to the latter during the brief time that her companionship was given to me I owe the inspiration which assisted me through the two critical years when I was just beginning to see light in regard to the specific limits of the Pisidia. It is to the late G. W. Chaster, I think, that I owe my original interest in this group. In 1905 he and I spent almost three weeks alone together in N.W. Donegal, during which I received much enlightenment on the subject of our mutual interest. At that time Dr. Chaster did not pretend to know the Pisidia, but I have a distinct recollection that on parting that year there was an understanding that "some day when we had more time" we would look into the matter. That some day for him never came for he died in harness almost on the eve of a visit to Kerry five years later and it was not until I was married and went to live in the country that I had time to do any work at the Pisidia, just after the outbreak of war in 1914. But during those nine years I collected mollusca very extensively in all the counties of Ireland, except Tipperary; in the S.E. of England, as well as in Cornwall and odd localities in many parts of that country; in the Orkneys; in Norway; and in Normandy. Wherever and whenever I had an opportunity I brought home Pisidia, always with the idea that "some day" I would tackle them. On some occasions my specimens were named by various conchologists for purposes of recording, but the vast majority of these shells in my collection remained unexamined until after 1914.

I can well remember collecting my first *Pisidium*. It was in a ditch in fields now long since built over by the extension of Belfast—but I still have the specimen—*P. casertanum*—and the *Aplecta hypnorum* that I collected with it. In those days Mr. Robert J. Welch was my only guide and friend and we kept a careful log of all our captures. It was then our custom to record our Pisidia as either "*P. amnicum*", "*P. pusillum*" or "P.sp ?". *P. amnicum* we did not often see, as our collecting was mostly done in areas beyond its range. "*P. pusillum*" we recorded without scruple as we thought it could do no harm, since the species was supposed to be ubiquitous. The other species we never dared to name.

It was with great joy, therefore, that when collecting near Sligo in September 1900, I heard Mr. Robert Standen name a *Pisidium* which we had found in an old limestone quarry. He said it was "*P. roseum*" (i.e. *P. milium* of course) and from that day I named *P. milium* with fair success. Also if a specimen was very inequilateral we could sometimes venture to call it "*P. fontinale*"; or if it was very clean and glossy it was "*P. nitidum*". About this time, 1898–1905, much of our material was sent to Mr. Charles Oldham whose naming was wonderfully consistent when we consider that he was trying to put ten or twelve species into five rather ill-defined forms. Not till the Clare Island Survey was started in 1909 and I had been asked to undertake the report on the L. and F.W. Mollusca did the problems of the Pisidia really assert themselves. During the survey I made many collections on oecological lines, which afterwards proved of the utmost value. I was saved, however, from floundering into the unknown, by learning that Mr. B. B. Woodward was writing a monograph on the British Pisidia and I was led to understand that he would be glad to see Irish material—though I have since discovered that I was mistaken on the latter point. Mr. Woodward being willing to name my Pisidia I naturally placed my Clare Island collections at his disposal, as it relieved me of the responsibility of trying to identify them—a task which I knew well I could not rightly undertake.

When we consider that Mr. Woodward's chief experiences in the group were founded on the robust shells from the hard water of the Thames basin, the identification of those from the peat-covered areas of W. Mayo must have presented a most difficult and puzzling task, especially as he had seen little or no Irish material previously. Allowing for this, his recognition of *P. hibernicum* from Inishbofin was really an excellent piece of work. Naturally with the prospect of a monograph to help me I collected only Pisidia during the following years. With the long winter evenings of the country before me in 1914, I started with Mr. Woodward's catalogue and specimens named by him to try and learn the hinge characters. This stage lasted through the winter of 1914–15 and was attended by several misfortunes, for it so happened that the specimens I chose for types of several species had been wrongly named by Mr. Woodward. Hence at the end of this first stage I was little further on in my studies. During the second winter I persuaded my friend Mr. R. A. Phillips to join me in the work and we compared notes and sent each other specimens to name. This, the second stage, lasted well into the year 1916 and ended in our throwing aside all Mr. Woodward's identifications and starting afresh on our own lines. These lines were, to work oecologically, to see what species we could identify from certain restricted habitats and to see if our specific characters would hold good for examples from other habitats. Finally having isolated what we considered to be species, we tried to name these. My first habitat was a small stream, serving a water-mill, a little inland from Ballyholme, near Bangor, Co. Down. In this I found three definite and distinct species, namely *P. subtruncatum*, *P. nitidum* and unfortunately *P. hibernicum*. I say "unfortunately" because at that time, owing to its supposed rarity, the finding of *P. hibernicum* seemed impossible and for more than a year I tried strenuously to regard it as merely a variety of *P. nitidum*. In 1916 Mr. Phillips sent a sample of sand dredged from the River Suir at Fiddown, near Waterford, and on examining this I found a single right valve of a minute *Pisidium* whose hinge characters were so distinct that I at once concluded that it was a new British species and guessed that it might belong to the *P. parvulum* of Mr. Woodward's Catalogue. Other specimens were soon forthcoming and as Mr. Phillips agreed with me, in my opinion regarding its identity, we sent it to Mr. Woodward for his opinion. He replied that it was young *P. supinum*. The confidence we retained in our own opinion led to the breaking down of direct communication between myself and Mr. Woodward, who considered it was impertinent on my part not to accept his verdict, in spite of the fact that all my instinct led me to believe that these little shells were adults and not "mere fry". In attempting to rectify his position Mr. Woodward has complained that he has not been given an opportunity to alter his opinion in some cases of naming where I have had to point out that he was wrong. Possibly he has just grounds for complaint, but he must admit to himself, I think, that this state of affairs is due to his own actions in insulting us on the first occasion that we attempted to urge him to change his opinion about the identity of a *Pisidium* and this rendered future correspondence with him utterly out of the question. Two courses were left open to me to pursue. One, which I have followed, was to place in print the more important points that my researches led me to differ in from Mr. Woodward, the other was to drop my studies of the group completely—an achievement which, I cannot help thinking, Mr. Woodward hoped to attain by his letters to me. At least I can put no other possible interpretation upon it. My only aim has been to clear away the mist which enshrouded the specific characters of the Pisidia. Mr. Woodward seems always to assume that my interests lie with him, whereas on the contrary they are wholly with the Pisidia. In order to prove that the shells, which we considered to be *P. parvulum* of Woodward's Catalogue, were not merely young *P. supinum*, I enlisted the sympathy of Mr. Charles Oldham, who sent me at the first opportunity living specimens of both species, which at once confirmed our previous conclusions, which in 1921 Mr. Woodward has had to accept (*Proc. malac. Soc. Lond.* **14** : 209–220). Had he not lost control of his feelings we could have proved this to him in 1916. Mr. Oldham's dormant interest was by this means aroused and since that date he has formed with Mr. Phillips and myself a small but exclusive Pisidium Club. The notes which follow are the result of our joint labours. Both my colleagues being men whom I must describe as too damnably modest for words, it has fallen to my lot to put our results down on paper; in the hope that they may at a future time be of some use to a student of the genus and that they may save his time or otherwise help him in his researches, not that we believe for a moment that they represent anything approaching the last word on the subject. From personal experience I have a little advice to give to all students. Satisfy yourself about all points of evidence before using it or building on it! Do not be bluffed by self-appointed authorities who thunder opinions at you before an audience that is unable to criticise their work, but who refuse to discuss these opinions with you. Authorities who, perhaps, never collected living *Pisidium* in their lives, and who, to cover up this lamentable fact, record shells not under the name of the collector, through whose generosity they obtained their material; but under the names of the persons in whose collections the shells temporarily rest—usually their own collection. Always help the beginner, if for no other reason, than in the hope that he will one day, like the mouse in the fable, be in a position to cut the net which entangles you!

In conclusion I say that I have no doubt that in time to come many "species" will be added to the British list but I cannot avoid hoping that breeding experiments may eventually prove that the species herein recognised are really species in the generally accepted meaning of the word and not composite agglomerations of diverse forms. If I may offer a suggestion to future workers, go in for breeding! Take a plastic species like *P. casertanum* from a standard locality where it is fairly constant and breed its progeny for a number of generations under different environments and see what happens!

A. W. Stelfox
26 September 1922

GENETICAL STUDIES

A. W. Stelfox ranks with Oldham and Diver as a major investigator of the genetics of helicid snails. All of them carried out breeding experiments in the time left over from other activities, but in this way discovered or confirmed a very large body of comparative information on *C. nemoralis*, *C. hortensis*, *H. aspersa* and *A. arbustorum*. Although they published little their work has been influential as a result of discussion, correspondence and exhibition at scientific meetings.

Stelfox began to breed snails at the beginning of the century, starting when he decided to raise to adulthood for his collection some rare varieties of *Cepaea* taken as juveniles. His principal work on Mendelian genetics was carried out between 1910 and 1930. Later he kept numerous stocks, but did not pursue the avenues he had opened, such as the investigation of linkage and the detailed study of the wide range of colours found in Irish *C. nemoralis*. Instead, he turned his attention to the inheritance of size and shape, a much more difficult field of study when working with a slow-growing species. He never thought of himself as a geneticist, being more concerned with the ecology and distribution of land mollusca; indeed, his comments on genetical work of his contemporaries were sometimes quite tart. This makes his varied contributions to the genetics of the group the more impressive. The following notes, which trace the course of his genetical activities, are taken from a review by L. M. Cook published in 1970 in the *Irish Naturalists' Journal* (Vol. 16, 249–52).

The genetics of *Cepaea* were first investigated at the beginning of this century by Arnold Lang. Among other things, Lang established the dominance relations of many of the major genes. Stelfox's early papers on snail genetics, which were published in 1915 and 1918, do the same for the *exalbida* form of *Helix aspersa*, controlled by an allelomorph recessive to the typical dark form, and add to the data on *C. nemoralis*. He showed that hyalozonate banding is recessive to full banding, while punctate, or interrupted banding, is a dominant trait; and that yellow colour is recessive to pink. In addition, the papers contain observations on the biology of the species and on features such as variation in band formula between individuals in a brood, the genetic basis of which has never been fully analysed. He also noticed something that was not understood until the work of Cain and Sheppard many years later, namely that completely unbanded individuals may arise among the progeny of extreme punctate parents.

There followed a period of intensive breeding of *C. nemoralis* and *C. hortensis* in which Stelfox investigated the genetic control of banding variants and of the unusual colour forms of *nemoralis* that occur in Ireland. Some of the results were displayed by Diver at the Sixth International Congress of Genetics in 1932, and must have influenced many workers on genetics and evolution at the time. Most of the breeding was concerned with the effects of allelomorphs at single loci, but Stelfox also contributed to knowledge of the linkage relationships of the genes, his results being quoted in 1934 in a paper on linkage by Sir Ronald Fisher and Diver, and referred to in the 1932 Congress report.

While investigating segregating factors, Stelfox also took an interest in the non-segregating trait shell size in *Cepaea nemoralis*. The mean dimensions in populations of this species have long interested naturalists in Ireland, owing to the curious distribution of large forms about the country. The species is widespread, being present in all counties, and the shells are usually similar in size to British ones. In some areas, however, there are populations of large-shelled individuals, often with a high frequency of the recessive character white lip. Stelfox did much to establish the distribution of the species and of the variant forms. He bred some from two localities, showing that the large size persisted through several generations in the environment of the breeding boxes, where they remained quite distinct from lineages of small-shelled individuals. One of his last papers on molluscs, published in 1968, describes the results of an attempt to modify the expression of another non-segregating trait, scalariformity. Stelfox found a "nice scalariform specimen" of *C. nemoralis* at Strandhill while on the Irish Field Club excursion in 1904. Another appeared unheralded in one of his breeding experiments, all the relatives being completely normal in shape. In helicids these aberrant individuals are always rare in the wild and apparently of low viability. Stelfox began selective breeding of *H. aspersa* to investigate the condition by crossing two individuals with comparatively high spires that he had found in his garden. In each generation the progeny with the most conical shape were selected, and in his hands the experiment continued over more than a dozen generations. During this period extreme scalariform individuals were produced, showing conclusively that control of shell shape has a genetic component which is responsive to selective breeding. These lines are now being maintained by others. The bulk of his bred material was presented by him to the Manchester Museum, where it forms a very valuable reference collection.

L. M. Cook

LIST OF CONCHOLOGICAL PAPERS BY A. W. STELFOX

It is believed that the following list is complete so far as Stelfox's conchological papers are concerned, but no attempt has been made to catalogue his entomological papers nor his very many botanical and miscellaneous notes.

1904

(With R. Welch) The Mollusca of Bushy Park, Dublin. *Ir. Nat.* **13** : 121–126.

(With R. Welch) Irish Field Club Union. Report of the Fourth Triennial Conference and Excursion held at Sligo, 12 to 18 July 1904. Mollusca. *Ir. Nat.* **13** : 183–193.

1906

The land and fresh-water Mollusca of North-West Donegal. I. Bunbeg, Gweedore, Horn Head, and Glenveagh Areas. *Ir. Nat.* **15** : 62–67.

(With J. N. Milne) Some new Molluscan Records for Co. Tyrone. *Ir. Nat.* **15** : 75.

(With J. N. Milne) A new station for *Helix virgata*. *Ir. Nat.* **15** : 76.

Helicella zakarensis in Co. Down. *Ir. Nat.* **15** : 110–111.

1907

(With R. Welch) Contributions to the Natural History of Lambay. Land and Fresh-water Mollusca. *Ir. Nat.* **16** : 41–42.

(With R. Welch) Irish Field Club Union. Report of the Fifth Triennial Conference and Excursion, held at Cork, 11 to 16 July 1907. Land and Freshwater Mollusca. *Ir. Nat.* **16** : 273–286.

(With J. N. Milne) Further Notes on the land and freshwater Mollusca of Cork West and Kerry. *Ir. Nat.* **16** : 287–288.

Some notes on the Land and Freshwater Mollusca of Galway and District. *Ir. Nat.* **16** : 353–364.

1908

(With R. Welch) Mollusca of Bushy Park, Dublin (Additions). *Ir. Nat.* **17** : 23.

The Colonization of Mollusca. *J. Conch.* **12** : 140.

1909

Additional notes on the Land and Freshwater Mollusca of north-west Donegal. *Ir. Nat.* **18** : 86–92.

Additional localities for the new Irish *Vitrina*. *Ir. Nat.* **18** : 204.

Land and Freshwater Mollusca from Tooting, London, S.W. *J. Conch.* **12** : 292–293.

1910

(With A. S. Kennard) On the occurrence in England of *Valvata macrostoma* Steenbuch. *Proc. malac. Soc. Lond.* **9**: 123.

(With R. Welch) Irish Field Club Union. Report of the Sixth Triennial Conference and Excursion held at Rosapenna, 8 to 13 July 1910. Land and freshwater Mollusca. *Ir. Nat.* **19**: 172–178.

Is *Hyalinia helvetica*, Blum found in Ireland? *Ir. Nat.* **19**: 210–211.

The distribution of *Bythinia leachii* in Ireland. *Ir. Nat.* **19**: 240.

Some records of Land and Freshwater Mollusca from the Counties Roscommon and Longford. *Ir. Nat.* **19**: 241–242.

1911

A List of the land and freshwater Mollusks of Ireland. *Proc. R. Ir. Acad.* **29** B: 65–164.

Hyalinia Rogersi introduced at Hillsborough. *Ir. Nat.* **20**: 77.

1912

Clare Island Survey. Land and Fresh-water Mollusca. *Proc. R. Ir. Acad.* **31**: part 23.

The Terrestrial Mollusca of the Great Blasket and Beginish. *Ir. Nat.* **21**: 185–190.

The occurrence of *Helicella heripensis* (Mabille) in Great Britain. *Proc. malac. Soc. Lond.* **10**: 39–41.

Notes on some British non-marine Mollusca. *Proc. malac. Soc. Lond.* **10**: 42–44.

1913

On *Hygromia rufescens*, auct. in Ireland. *Proc. malac. Soc. Lond.* **10**: 290–291.

Limax cinereo-niger Wolf. *Belfast Naturalists' Field Club Quarterly Journal* **I**: 7–8.

1914

John Templeton's Notes on Irish land and fresh-water Mollusca. *Ir. Nat.* **23**: 29–35.

On references by W. E. Leach to Irish land and fresh water shells. *Ir. Nat.* **23**: 35–36.

Land and freshwater Mollusca of the valley of the Roe, Benevenagh and Magilligan, Co. Derry. *Ir. Nat.* **23**: 125–132.

The life history and habits of our freshwater bivalve shells. *Belfast Naturalists' Field Club Quarterly Jaurnal* **I**: 33–35.

1915

A cross between typical *Helix aspersa* and var. *exalbida*: its results and lessons. *J. Conch.* **14**: 293–295.

A list of the land and freshwater Mollusca of the Dingle promontory. *Ir. Nat.* **24**: 17–37.

1916

The record of *Paludestrina jenkinsi* Smith for the Aran Islands.—A Correction. *Ir. Nat.* **25** : 83–84.

1917

Otina otis (Turton) on the county Down coast. *Proc. malac Soc. Lond.* **11** : 318–319.

1918

(With R. A. Phillips) Recent extensions of the range of *Pisidium hibernicum*. *Ir. Nat.* **27** : 33–50.

On the recent misapplication of the names *Pisidium nitidum* and *Pisidium pusillum* of Jenyns. *J. Conch.* **15** : 235–239.

Researches into the hereditary characters of some of our British Mollusca. Part II. *J. Conch.* **15** : 268–275.

The *Pisidium* fauna of the Grand Junction Canal in Herts. and Bucks. *J. Conch.* **15** : 289–304.

James Napier Milne. *Ir. Nat.* **27** : 129.

1919

Notes on the lake-forms of *Limnaea pereger*. *Ir. Nat.* **28** : 9–12.

Pisidium parvulum in Co. Antrim. *Ir. Nat* **28** : 92–93.

1920

Local Mollusca from north-east Ireland. *Ir. Nat.* **29** : 122–123.

1921

Pisidium clessini in British lochs. *Nature London* **108** : 40–41.

1922

On the *Pisidium gassiesianum* of Dupuy. *Proc. malac. Soc. Lond.* **15** : 52–53.

Report on the Gassies collection of Pisidia in the Musée d'histoire naturelle de Bordeaux. *Proc. malac. Soc. Lond.* **15** : 54–57.

Helicella heripensis : supposed Occurrence in Ireland. *Ir. Nat.* **31** : 11.

1923

Helicella itala L. : an addition to the Fauna of Lambay. *Ir. Nat.* **32** : 87.

Water snails and liver fluke. *Nature London* **111** : 49.

1924

Helicella heripensis in Ireland. *J. Conch.* **17** : 182.

Helicella heripensis in Co. Kildare. *Ir. Nat.* **33** : 67.

1925

Vertigo genesii Gredler in Ireland. Part I. *J. Conch.* **17** : 236–240.

1927

Paludestrina jenkinsi in Lough Neagh and elsewhere. *Ir. Nat. J.* **1**: 174–175.

1929

Land and freshwater Mollusca: *in* Report on recent additions to the Irish fauna and flora (terrestrial and freshwater), by R. Ll. Praeger. *Proc. R. Ir. Acad.* **39** B: 6–10.

The pond snail, *Limnaea glabra,* rediscovered in Ireland. *Ir. Nat. J.* **2**: 182–183.

The garden snail. *Ir. Nat. J.* **2**: 240–242.

The habitats of *Vertigo lilljeborgi* West. in Ireland. *J. Conch.* **18**: 313–315.

1931

Rare slug in north Co. Dublin. *Ir. Nat. J.* **3**: 197.

1935

The limpet as a cat-catcher. *Ir. Nat. J.* **5**: 229–230.

1936

Trochus (= *Monodonta*) *lineatus* living on the coast of Dublin. *Ir. Nat. J.* **6**: 146.

1937

The slug *Milax gracilis* in Co. Dublin. *Ir. Nat. J.* **6**: 228.

1940

Fauna List: *in* Studies on Irish Quaternary Deposits: some lacustrine deposits near Dunshaughlin, County Meath, by G. F. Mitchell. *Proc. R. Ir. Acad.* **46** B: 36.

1941

Fauna List: *in* Studies on Irish Quaternary Deposits No. 2. Some lacustrine deposits near Ratoath, Co. Meath, by G. F. Mitchell. *Proc. R. Ir. Acad.* **46** B: 182.

1942

(With A. M. Gwynn and G. F. Mitchell). The Exploration of some caves near Castletownroche, Co. Cork (Studies in Irish Quaternary Deposits no. 4). *Proc. R. Ir. Acad.* **47** B: 371–390 (Moll. p. 385).

Extension of the known range of *Vertigo moulinsiana* in Ireland. *Ir. Nat. J.* **8**: 37–38.

1943

Lymnaea palustris in captivity. *J. Conch.* **22**: 72.

1945

A large race of *Cepaea nemoralis* L. (and other Mollusca) at high altitudes in the Galtee Mountains, Co. Tipperary South. *J. Conch.* **22**: 168.

Cepaea nemoralis L. in the Dartry Mountains. *J. Conch.* **22**: 170.

1946

Some Pisidia from the tarns of the Galtee Mountains, Co. Tipperary South. *J. Conch.* **22**: 176.

Robert Albert Phillips (1866–1945). *J. Conch.* **22**: 205.

1947

The Kerry slug (*Geomalacus*) in the Dingle Peninsula. *Ir. Nat. J.* **9**: 100.

1952

(With N. F. McMillan) Survey of Inishtrahull: Part 6 (Report on the Mollusca collected by Messrs. Ranald MacDonald, B.Sc., and D. J. Sullivan). *Ir. Nat. J.* **10**: 232–235.

Mollusca at high altitudes in the Scottish highlands. *J. Conch.* **23**: 271–272.

1958

A short history of the known occurrences of *Helicella gigaxi* (L. Pfeiffer) in Ireland. *J. Conch.* **24**: 283–284.

1959

Potamopyrgus jenkinsi (Smith) in West Donegal. *J. Conch.* **24**: 358.

1962

(With N. F. McMillan) *Viviparus viviparus* (L.) in Ireland. *J. Conch.* **25**: 117–121.

1963

Is *Agriolimax caruanae* a native slug? *Ir. Nat. J.* **14**: 101–102.

1966

(With N. F. McMillan) The distribution in Ireland of very dark forms of *Cochlicella acuta* (Muller). *J. Conch.* **26**: 51.

1968

On the inheritance of scalariformity in *Helix aspersa*. *J. Conch.* **26**: 329–332.

1969

Marpessa laminata (Montagu) bred in a small box for fifty-four years. *J. Conch.* **27**: 11–12.

1971

(With G. F. Mitchell) Late glacial deposits at Ballyclander, near Downpatrick, Co. Down. *Ir. Nat. J.* **17** : 19–20.

1972

(With J. G. J. Kuiper, N. F. McMillan and G. F. Mitchell). The late-glacial and post-glacial Mollusca of the White Bog, Co. Down. *Proc. R. Ir. Acad.* **72** B : 185–207.

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REVIEW

Latin and Greek for Biologists by Theodore Savory. Merrow Technical Library: Biology, Watford: Merrow Publishing Co. Ltd., 1971, pp. vii + 34. 8½″ × 5½″. Price £1.25 (U.S.A./Canada $4.00).

This little book, by a well-known schoolmaster arachnologist, is a revised edition of one published by the University of London Press in 1946, which the author says "was a consequence of my encounter with a phenomenon that was then new to me: the arrival in my Science Sixth of a boy who had never learnt a word of Latin or Greek." Though primarily directed at sixth form biologists, it will be found informative by those of maturer years who have never enjoyed the privilege (or have escaped the ordeal) of a grounding in the classics. The first chapter treats in an elementary way of Latin and Greek grammar. Chapter 2 gives a list of some of the biological terms derived from these two languages. Chapter 3 consists mainly of outline classifications of the animal and plant kingdoms with derivations of the group names (that of the animal kingdom is not entirely up to date). The final chapter comprises 26 exercises, which are quite as entertaining and far more instructive than the daily crossword puzzle. The short list of books for further reading surprisingly omits Lancelot Hogben's *The Vocabulary of Science* (Heinemann, 1969).

A reviewer is expected to spot any errors, if only to prove that he has read the book. On page 4, paragraph 2, the misprint of the Greek ν (nu) for γ (gamma) will puzzle the uneducated. On page 6 is a reference to 40 orders of insects, but only 20 are cited in the classification (pp. 20, 21). On page 8, in the phrase "female frogs or cock sparrows" the sexes should be reversed to make sense in the context. Page 23, *Unio* is not an oyster, but a freshwater mussel.

The basic agreement between author and reviewer is illustrated by the two following quotations: "Since biologists are compelled to make new words, they should make them well, not badly. There is no merit in deliberate illiteracy" (Savory, p. 28). "It behoves those who draw from classical springs not to muddy the water" (*The Conchologists' Newsletter*, No. 22, p. 16, 1967). Why the publishers regard an enormous photograph of a rhinoceros beetle as an appropriate embellishment of the dust-jacket is not apparent to

A. C. Ellis

J. Conch. **27**: 535–543 (1972)

OBITUARY

CYRIL PHILIP CASTELL, 1907–1972

Cyril Philip Castell, B.Sc., died on Friday, 25 February 1972, after a long illness which followed a stroke he suffered not long after he retired. He was 64. Castell was a true all-round naturalist as well as a scientist, and his passing will be greatly mourned by those who knew him and those who consulted his writings.

Castell was born on 30 June 1907. His education was halted at the age of 19 when his father suffered a stroke which left him incapable of work until his death about 1948. To support his parents, he entered the service of the Trustees of the British Museum on 20 December 1926 as a Boy Attendant at the Natural History Museum, South Kensington. His wage was 35 shillings a week. He worked for a while in what was then called the Geology Workshop (later the Palaeontology Laboratory) under Mr. L. E. Parsons and Mr. F. O. Barlow. When he joined the Workshop, he was asked if he had had any experience as a stonemason, this skill reminiscent of Hugh Miller's day apparently at that time being considered a desirable ability for a fossil-preparator. He and a few others joining the Museum at about the same time were the first of a new breed of staff, who although without university degrees, were certainly capable of attaining them. It is certain that if Castell's education had not been interrupted by the need to support his parents, he would have gained the highest honours. Undaunted, however, he studied Geology and Botany in his spare time and obtained the degree of Bachelor of Science. He then applied for a transfer to the Department of Botany at the Museum, but this was turned down. He remained in the Department of Geology (as it was then known) under Dr. L. R. Cox on the Mollusca Group. Castell's zeal is indicated by the fact that most of the Group's collections, some several thousand drawers of fossils, were curated by him. For a period during the Second World War he worked in the Geological Survey and Museum building (now the Institute of Geological Sciences) on the wartime well records project (Holmes and Castell, 1945) and was frequently a fire-watcher on the roofs of the various museum buildings during the bombing.

In the 1950s, the staff of the Mollusca Section was increased to about half-a-dozen, and in his later period of service, in the rank of Senior Experimental Officer, Castell was placed in charge of British Caenozoic Mollusca. I joined him in 1958 as his assistant, and together we tackled the Tertiary and especially the Quaternary Mollusca collections. About this time, the "British Fossils" handbooks became a reality: originally, the idea was to have a cabinet of characteristic British fossils in a public gallery of the Museum so that students and the idly curious could view them, but the idea was translated into book form. Castell, under the general supervision of Dr. L. R. Cox, threw himself into this mammoth task, advising artists, extracting fossils and notes from other members of the staff and making sure the whole thing fitted together.

He lived in Wimbledon all his life, and it is clear from his earlier papers that Wimbledon Common and its natural history gave him the impetus for his life-long interest in the natural sciences. He joined the London Natural History Society in 1932 and his support for this society is shown in his position on its Council and in many committees, and by his numerous papers in their journal, particularly those pertaining to Bookham Common. The hut later erected at Bookham Common for the furtherance of survey work was named the Castell Research Centre a couple of years before his death in recognition of his work there.

Castell was Hon. Secretary of the Wimbledon Natural History Society during its life from 1933–1939. He also found time to be on the Council, and later on the Editorial Committee, of the British Empire Naturalists' Association from 1936 until at least 1948. He was elected a member of the Conchological Society in 1945 and was its Hon. Secretary from 1951–1959 and President 1960–1962. He gave two Presidential Addresses. "*Some Notes on London's Molluscs*" [a typically modest title] delivered 18 February 1961 (published July 1962) and "*The contribution of Kennard and Woodward to the history of British non-marine Mollusca*", delivered 17 February 1962, but due to some disagreement, has unfortunately remained unpublished hitherto.

He became Recorder for Hepatics [Liverworts] for the British Bryological Society from 1948–1960 and after many years service to the London Natural History Society became its President for 1957–1958. He gave two Presidential Addresses, on the "*Climate and Vegetation of the London Area in Prehistoric Times*" (1959) and "*The Animal Life of Prehistoric London*" (1960). He was indeed an all-round naturalist, his first love being botany, but he was also interested in palaeontology, molluscs, ornithology, microscopy, etc. Listening to classical music was a favourite pastime of his (he could play the piano quite well) though one wonders how much time he really did have to himself, as he was a member of about a score of societies, including the Malacological Society of London (member 1945–1969, on Council 1949–1952), Geological Society of London, Geologists' Association, and later the Tertiary Research Group. It will be evident to those who knew him just how much of his time he gave to the advancement of natural history, both as a writer and in the less glamorous but vital work of helping to run societies.

A fossil freshwater bivalve, *Unio castelli* Woodward, was named in his honour (Woodward, F. R., 1967. Monograph of the British Lower Tertiary Unionidae. Additions and Corrections. *J. Conch. Lond.* **26** : 197–200, pl. 9).

Castell retired on 30 June 1967, after 40 years' service at the British Museum (Natural History), hoping for a long retirement to finish off and write many more papers, to sort through his many packets of mosses and enjoy his gramophone music. Alas, this was not to be, for only a few months later, in November 1967, he suffered a stroke which left him paralysed on the right side of the body and impaired his speech for a while. Fortunately his mental faculties were in no

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way affected and after a brain operation he recovered sufficiently to begin to walk again with the aid of a stick. While in a convalescent home, he fell and broke his paralysed right leg. This was a major setback to his recovery, and later he had an operation for the removal of a gallstone. So, for four years, almost from the moment of his retirement, he was in great pain and misery, though he bore the burden with great courage and fortitude. He managed to write a few notes for the *London Naturalist* (1968 and 1970) and produce a mollusc report (Castell and Cooper, 1972) during this time, but the difficulties attending his illness prevented him from completing any more papers. He was unmarried, with no relatives except his ailing and aged mother who died in November 1971, aged about 93. Castell passed away in his sleep a few months later, probably from another stroke. He was interred in the family grave in Wimbledon Cemetery, Gap Road, Wimbledon, on 3 March 1972. The service was attended by his friends and Museum colleagues, all of whom deeply regret his passing.

I wish to thank Mr. A. Rissoné for his skill in reproducing the photograph of Castell which accompanies this obituary. It was prepared from a group photograph taken in June 1955.

There follows a list of Castell's papers which I have been able to trace. I make no claim that the list is exhaustive, particularly in the earlier years.

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LIST OF PUBLICATIONS OF THE LATE CYRIL PHILIP CASTELL

by

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This list does not claim to be fully comprehensive and it has not been possible to check some of the archaeological references. The scope of the journals will be a guide as to where to search for other possible papers.

1933. Nature in Wimbledon in the 'Eighties. *J. Wimbledon nat. Hist. Soc.* vol. 1, no. 2, pp. 13–15.

1934. The Vegetation of Wimbledon Common. *J. Wimbledon nat. Hist. Soc.* vol. 2, no. 2, p. 15.

1935. Plant Life on the Common in Early Spring. *J. Wimbledon nat. Hist. Soc.* vol. 3, no. 1, pp. 4–5.

1935. The function of the local natural history society. *J. Wimbledon nat. Hist. Soc.* vol. 3, no. 2, p. 15.

1935. The Natural History of Tooting Common fifty years ago. *J. Wimbledon nat. Hist. Soc.* vol. 3, no. 4, pp. 29–31.

1936. Fossils and the Value of their Study. *Countryside* NS vol. 10, no. 11, pp. 488–490, 2 text-figs.

1936. The Woodlands of Wimbledon Common. I. The Birch. *J. Wimbledon nat. Hist. Soc.* vol. 4, no. 1, pp. 5–7.

1936. Our herbarium and local plant records. *J. Wimbledon nat. Hist. Soc.* vol. 4, no. 2, p. 11.

1937. The Woodlands of Wimbledon Common. II. The Tree Layer. *J. Wimbledon nat. Hist. Soc.* vol. 5, no. 1, pp. 3–6.

1937. The Society's Local Records Scheme. *J. Wimbledon nat. Hist. Soc.* vol. 5, no. 2, pp. 9–11.

1937. The Society's Local Records Scheme. Preliminary Bibliography. *J. Wimbledon nat. Hist. Soc.* vol. 5, no. 3, pp. 18–21.

1937. The Woodlands of Wimbledon Common. III. The Undergrowth. *J. Wimbledon nat. Hist. Soc.* vol. 5, no. 4, pp. 25–28.

1937. Presentation to the Editor. *J. Wimbledon nat. Hist. Soc.* vol. 5, no. 4, p. 32.

1938. The Earth's Oldest Plants. The Story of an Ancient Scottish Flora. *Countryside* NS vol. 11, no. 8, pp. 358–360, figs. 1–16.

1938. Soil Acidity *in* The Survey of Limpsfield Common. *Lond. Nat.* for 1937, pp. 51–53.

1938. Bryophyta *in* The Survey of Limpsfield Common. *Lond. Nat.* for 1937, pp. 53–55.

1938. The Woodlands of Wimbledon Common. IV. The Seasonal Aspects and General Conclusions. *J. Wimbledon nat. Hist. Soc.* vol. 6, no. 4, pp. 3–5.

1938. The Liverworts of Wimbledon Common. *J. Wimbledon nat. Hist. Soc.* vol. 6, no. 4, pp. 44–46.

1939. A Vegetation Map of Limpsfield Common and some preliminary ecological notes. *Lond. Nat.* for 1938, pp. 55–60, 1 map.

1939. The Mosses of the Society's Area. Supplement to vol. 7, no. 1. Separately paginated: pp. 1–4. *J. Wimbledon nat. Hist. Soc.* vol. 7, no. 1.

1939. The Mosses of the Society's Area. *J. Wimbledon nat. Hist. Soc.* vol 7, no. 1, p. 10.

1939. Notes on our Common Conifers (from a lecture given by Mr. C. P. Castell on 21 February). *J. Wimbledon nat. Hist. Soc.* vol. 7, no. 3, pp. 31–33.

1943. The Survey of Bookham Common. First Year. Some Preliminary Observations on the Base Map and Topography. *Lond. Nat.* for 1942, pp 28–31.

1943. Some Mosses of the Wall-top. *Countryside* NS vol. 12, no. 6, pp. 116–119, 1 text-fig.

1943. The Life Histories of Mosses and Ferns. *Countryside* NS vol. 12, no. 8, pp. 177–181, 1 text-fig.

1944. The Survey of Bookham Common. Second Year. Progress Report. *Lond. Nat.* for 1943, pp. 22–23. (C.P.C. and R. M. Payne)

1944. Carrington, L. I., Castell, C. P., and Wilton, A. R. Some Preliminary Notes on the Birds of Bookham Common. *Lond. Nat.* for 1943, pp. 23–29, 2 maps.

1944. Some more Mosses of the Wall-top. *Countryside* NS vol. 12, no. 10, pp. 231–234, 1 text-fig.

1944. An addition to the Coventry Flora. *Countryside* NS vol. 12, no. 10, p. 246.

1945. In search of Woodland Mosses. *Countryside* NS vol. 13, no. 1, pp. 6–9, 2 text-figs.

1945. Some more Woodland Mosses. *Countryside* NS vol. 13, no. 2, pp. 31–34, 1 text-fig.

1945. Holmes, S. C. A., and Castell, C. P. Water Supply from Underground Sources of Bath–Bournemouth District. Pt. VIII, Well-Catalogues for New Series One-inch sheets 298 (Salisbury) and 299 western half (Stockbridge). Wartime Pamphlet no. 41, Department of Scientific and Industrial Research, Geological Survey of Great Britain.

1945. The Survey of Bookham Common. The Ponds and their Vegetation. *Lond. Nat.* no. 24, pp. 15–22.

1946. Moss Leaves under the Microscope, I. *Countryside* NS vol. 13, no. 10, pp. 268–270, 1 text-fig.

1946. Moss Leaves under the Microscope, II. *Countryside* NS vol. 13, no. 11, pp. 297–299, 1 text-fig.

1946. Trefoil or Medick? *Countryside* NS vol. 13, no. 11, p. 307, 1 text-fig.

1946. Reports on Plants sent in by members for distribution. True Mosses. *Rep. Br. bryol. Soc.* 1944–5, vol. 4, pp. 246, 252–269.

1947. Nature Conservation in the London Area. *Lond. Nat.* no. 26, pp. 17–41, 2 maps.

1947. The Survey of Bookham Common. Fifth Year. Progress Report. *Lond. Nat.* no. 26, pp. 81–82.

1947. The Fungi of Bookham Common. *Lond. Nat.* no. 26, pp. 83–87.

1947. [Review of] Introduction to Plant Ecology, by A. G. Tansley. *Lond. Nat.* no. 26, p. 130.

1948. The Survey of Bookham Common. Sixth Year. Progress Report. *Lond. Nat.* no. 27, pp. 49–51.

1948. New Vice-County Records. Hepaticae. *Trans. Br. bryol. Soc.* vol. 1, pt. 2, pp. 115–117.

1949. New Vice-County Records. Hepaticae. *Trans. Br. bryol. Soc.* vol. 1, pt. 3, pp. 212–214.

1949. How to begin the Study of Mosses and Liverworts. *Countryside* NS vol. 15, no. 1, pp. 7–14, 1 fig.

1949. The Survey of Bookham Common. Seventh Year. Progress Report. *Lond. Nat.* no. 28, pp. 45–46.

1949. The Fungi of Bookham Common. A supplementary list. *Lond. Nat.* no. 28, pp. 47–50.

1949. Bangerter, E. B., and Castell, C. P. Notes on the vegetation of the gun-pits and trenches on Eastern Plain, Bookham Common. *Lond. Nat.* no. 28, pp. 52–56, 1 map.

1949. [Review]. The Sea-shore life of Britain. *Lond. Nat.* no. 28, p. 121.

1950. New Vice-County Records. Hepaticae. *Trans. Br. bryol. Soc.* vol. 1, pt. 4, pp. 374–380.

1950. The Survey of Bookham Common. Eighth Year. Progress Report. *Lond. Nat.* no. 29, pp. 89–90.

1950. [Review]. A key to British Fresh and Brackish Water Gastropods, with Notes on their Ecology, by T. T. Macan. *Lond. Nat.* no. 29, p. 137.

1951. A new name for *Segmentina micromphala* (Sandberger). [*Segmentina sandbergeri* Castell]. *J. Conch. Lond.* vol. 23, no. 5, p. 169.

1951. An Introduction to Liverworts. *Countryside* NS vol. 16, no. 2, pp. 67–70, 1 text-fig.

1951. The Leafy Liverworts. *Countryside* NS vol. 16, no. 4, pp. 146–149, 1 text-fig.

1951. New Vice-County Records. Hepaticae. *Trans. Br. bryol. Soc.* vol. 1, pt. 5, pp. 491–496.

1951. The Survey of Bookham Common. Ninth Year. Progress Report. *Lond. Nat.* no. 30, pp. 41–42.

1951. Further notes on the vegetation of the gun-pits in Eastern Plain, Bookham Common. (Bangerter, E. B., and Castell, C. P.) *Lond. Nat.* no. 30, pp. 54–56.

1952. New Vice-County Records. Hepaticae. *Trans Br. bryol. Soc.* vol. 2, pt. 1, pp. 89–97.

1952. The Survey of Bookham Common. Tenth Year. Progress Report. *Lond. Nat.* no. 31, pp. 33–34.

1952. The Study of Fossil Pollen. *Countryside* NS vol. 16, no. 5, pp. 182–184.

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A fossil freshwater bivalve, *Unio castelli Woodward*, was named in honour of C. P. Castell: Woodward, F. R. 1967. Monograph of the British Lower Tertiary Unionidae. Corrections and Additions. *J. Conch. Lond.* vol. 26, no. 3, pp. 197–200, pl. 9.

J. Conch. 27: 544–551 (1972)

REVIEWS

Index Nudibranchia by H. D. Russell; published by the Delaware Museum of Natural History, 1971, 141 pp.

All nudibranch enthusiasts will be grateful for this compilation to Dr. Russell and his publisher. According to Professor R. T. Abbott's Foreword, the number of research papers dealing with nudibranchs has now exceeded 2,500, and the number of workers adding their publications annually to this total is in the neighbourhood of 100. Any catalogue which will help the malacologist to make use of the available literature is therefore welcome and Dr. Russell's contribution is substantial and, from the user's point of view, well designed.

The aim of this catalogue is to list, with full citations, all the research publications in which information about the Nudibranchia is comprised, and, furthermore, to break down this information into various classes. The most important of these classes is the Taxa catalogue, through which it is possible to locate an accurate reference to the original description for each specific and generic name ever employed in this group of molluscs.

I have two criticisms to make of this book. First, it is complete only up to 1965, regrettably, and secondly, it does not include any information about the Sacoglossa, a group usually included with the true nudibranchs for most purposes. But there is no doubt that it will be an invaluable aid to anyone wishing to carry out any serious work with naked opisthobranchs.

T. E. Thompson

The Oxford Book of Invertebrates by David Nichols and John Cooke, illustrated by Derek Whiteley. Oxford University Press, 1971. 218 pp., with 96 colour pls. 9¾ ins. by 7¼ ins. Price £3.00.

In two hundred fascinating pages the authors and artist have attempted to introduce to the readers a representative cross-section (623 in all) of the 30,000 or so species of invertebrates inhabiting the British Isles. Insects are not included in this book; so vast is their assemblage that they have a separate volume to themselves (*The Oxford Book of Insects*). The Mollusca occupy nearly one-third of the pages.

Once opened, this book is hard to close again. Every turn of the page reveals another attractive colour plate to stimulate the imagination, each one presenting an artistically arranged collection of animals more curious and beautiful than the last. Opposite each plate is a paragraph introducing the animals represented, followed by very good individual summaries of the salient features of each.

If *The Oxford Book of Invertebrates* is regarded as a stimulus to further studies, as a pleasant thing with which to while away a winter evening, or as a collection of pretty pictures, then it does its job admirably. Certainly it should find a place on the shelves of every "Junior Library". However, as a reference book it has some limitations. Derek Whiteley's plates are beautiful things, the colouring and layout being strongly reminiscent of P. H. Gosse's *A Year at the Shore*. They are, on the whole, quite finely drawn, but one feels that the artist is primarily an artist and not a scientist. He seems to have been captivated by the anemones and spiders, delineating them with a sympathetic eye guiding his pencil. The mollusca apparently were less closely observed. I challenge anybody to make a positive identificaton of the slugs (p. 63), which is a great opportunity missed as there are so few good slug pictures in print. Many snail species are drawn out of scale, which would not matter but that there is nothing in the plates or in the text to indicate the relative sizes. Zonitids, always a difficult group to beginners, are drawn without any attempt to show their diagnostic features. *Pupilla muscorum* could easily have been drawn from a specimen of *Lauria cylindracea*, a species which appears as an unrecognisable mote in the corner of another plate. *Cepaea hortensis* (p. 53) is quite clearly a 00300 form of *C. nemoralis*. A plain form of "*hortensis*" on the same plate has a well developed brown lip. The water snails (pp. 65, 71) are the poorest representations in the book, the animals apparently made out of clay by a child. These are the worst examples. The other mollusca, especially the "marines", are well executed, but obviously with less enthusiasm than the water fleas and parasitic worms and crustacea. All this is of small consequence to the average reader, who merely requires a nice picture to give him some idea of what the text is about, so as this is not a specialist's book we should not judge the plates by specialists' standards. They do their non-specialised job very well.

The co-authors have done a very good job, giving a reasonable amount of information about every species without boring repetition. They use scientific terms freely without "talking down" to their readers, a common fault in scientific books aimed at the general public. Unfamiliar terms can be looked up in the short glossary of terms at the end of the book, but a good biological dictionary will be needed by the layman to help him understand the glossary! For instance, *testis* is defined as "the male gamete producing organ", but we are not told what a gamete is. Similarly, an *introvert* is "an involuted portion of the body"; no indication of the meaning of involuted. They provide a very good up to date classfication down as far as orders, giving genera only as examples, but for some reason the insecta are totally excluded, presumably because they are in a different book. I think they should have been mentioned for sake of completeness.

Despite the above criticisms, *The Oxford Book of Invertebrates* will occupy a prominent place on my bookshelf and I am going to get a lot of use and entertainment out of it.

MICHAEL R. BLOCK

Shells on Cornwall's Beaches: identifying and collecting by Ann Pascoe. Tor Mark Press, Truro, n.d., pp. 36, with 2 colour and 2 monochrome plates. Price 18 p.

The time has gone by when even a scientist can expect to write an acceptable book on any scientific specialisation merely by culling snippets from the better known published literature. In a sense, therefore, this essay was fore-doomed, since it attempted what was virtually impossible. Even so, the attempt having been made, it is difficult to imagine any reason why such a work should be put before the public with such inefficient proof-reading. Consideration suggests that the main reason for the first may be the tempting profits to be made from the tourists, but such a public surely has a right to expect more carefully planned text than the present. To show that the stringency of these remarks is not founded on personal bias, it is only necessary to detail the more outstanding errors, obvious in only a superficial reading.

Hasty proof-reading is evidenced by small initial letters being accorded to genera a dozen times whilst in one instance a capital letter is given to a specific name. Misspelt names include "*paelliformi*" for "*patelliformis*", "*spinifex*" for "*spinifera*", "*ungarius*" for "*ungaricus*", "*Musculis*" for "*Musculus*", "*Madra*" for "*Mactra*" and both "*Dolina*" and "*Dosina*" for "*Dosinia*". On page 27, fig. 3, *Littorina littorea* is labelled as *Nucella lapillus*, fig. 1 on the same page shows not *Ensis ensis* but a worn example of *E. arcuatus*, and the figure of *Clathrus* (facing the list of contents) is reversed so that the shell appears to be sinistral. On page 22 the distinction between the "spiny" and "rough" cockle is correctly made, but the name *Cardium tuberculatum* is applied to both: the former is the species *aculeatum*, now placed by most conchologists in the genus *Acanthocardia*. Most conchologists likewise agree on the use of *Monodonta* rather than *Osilinus*, and *Venerupis* rather than *Tapes*, whilst although there is disagreement whether *Natica* or *Lunatia* should be employed, all agree that the species *alderi* and *natica* should be placed in the *same* genus. A few extra species have been admitted into the text: *Tellina radiata* is not a British species; there is no "related species" to *Pinna fragilis* in British waters; the "minor variety" *Patella crenata* is not a recognised taxon (and note that the other two common Cornish species of *Patella*—*P. depressa* and *P. aspera*—receive no mention); as yet *Urosalpinx cinerea* is restricted to the East Coast. The more serious errors of statement include *Calyptraea chinensis* and *Capulus ungaricus* living in chains like *Crepidula*, and the chitons being considered as univalve shells!

It would not be right to finish the review on this note, since considering its price, the book has some undoubted excellencies. These include the clarity and fidelity of the two colour plates, which also grace the front and back covers, the typesetting and the introduction. These first five pages of text are very informative and perhaps can only be faulted for stating that "locating sea shells and good sea shell localities is not a scientific process"—despite the fact that cogent reasons are presented to explain the distribution of both the living species and their shells around the Cornish coast. The chapter on making a collection is also useful although the present reviewer frowns "with some amateur conchologists" on lacquering shells and the use of boiling water or bleach; in all these instances the natural appearance of the periostracum is affected. There is a useful list for further reading at the back of the book, but even here initials are inverted (P. S. instead of S. P. Dance), and *Sea Shells of the World* is listed twice, for the Paul Hamlyn paperback is a reprint of the Golden Press edition; moreover the paperback would seem to be, flatteringly, attributed to the reviewer!

If this review seems to be unnecessarily long for so small and unpretentious a book, it is so merely to call attention to the large potential demand for popular regional works on conchology, and to show that this demand can be met by bright attractively produced paperbacks like the present reasonably priced brochure. However, it is also to register an expostulation on behalf of the consumers that are evidently envisaged, and to suggest that neither their needs nor that of conchology can be met by spurious work carelessly put together and lacking any of the corrections that one expects to be incorporated in any normal published text.

Stella M. Turk

British Prosobranch and Other Operculate Gastropod Molluscs Keys and Notes for the Identification of the Species (*Synopses of the British Fauna*, new series, no. 2) by Alastair Graham. Published for the Linnean Society of London by the Academic Press, London and New York. pp. 1–112, numerous text-figures. Stiff waterproof cover. 1971. Price £1.30.

This attractively produced work is one of the new series of the Linnean Society's well-known series *Synopses of the British Fauna*, and the author's name should be a guarantee that the work will be reliable. Nevertheless, the statement in the introduction that the keys "lead to the identification of the genus and then the species" is incorrect, as this is not by any means always the case. For example, on p. 77 we are told that there are several genera of British cerithiopsids but only one species of a single genus is mentioned. In the Trochidae *Cantharidus exasperatus,* so common in the Channel Islands, is omitted. It might be pleaded that a mainly Channel Island species does not deserve inclusion, no matter how common, but the omission of *Hydrobia neglecta* Muus is puzzling especially as in fig. 35 the pattern of pigmentation on the head of *Hydrobia ulvae* and *H. ventrosa* is illustrated.

On p. 87 only *Clathrus clathrus* is mentioned although neither *C. turtonis* nor *C. trevelyanus* is really rare. Under *Eulima* reference might have been made to Sykes' good paper and figs. (*Proc. malac. Soc. Lond.* **5**: 348–353. 1903). Marshall's critical notes on *Eulima* spp. appeared in *J. Conch.* **10**: 122–128. 1901.

Turning to Buccinidae one gets the impression that only two species of *Colus* are found in British waters; one wonders why *Colus islandicus* and *C. howsei* have been omitted as well as *Beringius turtoni* and *Volutopsius norwegicus*? In the Conidae it is the same; it is not even stated that other species do exist besides those listed. Fig. 100 shows a siphonal canal directed sideways, not straight as stated in the text. Some of the figures, especially those of the shells, are poor; those of the anatomy of the animals are very good (ex *British Prosobranch Molluscs*).

By the time the exasperated user has reached p. 109 he meets the statement that, despite the title, only about 140 gastropods have been dealt with out of a total fauna of about 230 species. The remainder, we are told, "are species which are so rarely found as not to deserve inclusion in a work of this type". Such incomplete keys are misleading and unfair to the student who, trying to determine an unknown species from them, will certainly be in difficulties; inevitably, the specimen one tries to identify is one NOT included.

It is a very great pity that Professor Graham's work was not extended to cover all the species of British prosobranchs and to appear (dare we say it?) in two numbers of the *Synopses* . . . Keys for all the British species would have been a real boon to all workers; instead, the present work is a useful general introduction, but not what it purports to be "Keys and Notes for the Identification of the Species"—it is only for *some* species.

The spaces left for notes by the user is an innovation, but one wonders how much they will be used? It might have been preferable to use the space to include a few more species.

The work is beautifully produced but seems rather dear at £1.30, especially as it will be necessary to resort to other works for so many species.

N. F. McMillan

Fourth European Marine Biology Symposium edited by D. J. Crisp. Cambridge University Press 1971. 599 pp. 22 plates (2 col.) and numerous figs. Price £12.40.

Yet another Symposium and this one, held at Bangor University College, N. Wales, in September 1971, had two themes "Larval Biology" and "Light in the marine environment". The foreword states that the aim of such meetings is to foster personal contact and offset some of the disadvantages of specialisation. The stimulus from exchange of views is difficult to evaluate, but the editor might have had more consideration for the specialist reader by consistently including the taxonomic positions of the subject species in the titles, as is the practice followed by the *Journals* of the Zoological Society of London, the Royal Entomological Society and the Marine Biological Association. It is also established practice to cite the author's name for a species both in the title and the first time the species is mentioned in the text: here it has been left to the discretion of the contributors. Professor Crisp's opening address reveals some most interesting historical and political aspects of the birth and growth of the present Marine Science Laboratories, not forgetting the possible poltergeist at Westbury Mount where it all started!

Six of the 41 papers are entirely on molluscs (larval forms) whilst five further papers are partly conchological (all except two of these on larvae). In his 29-page contribution on dispersal, Scheletema stresses the importance of the teleplanic larva (one with an extended planktonic life) in ensuring maximum distribution by ocean currents, and the reciprocal exchange of genetic links between benthic populations in the eastern and western Atlantic: a bibliography of 65 items underlines the difficulty of avoiding specialisation, a matter further exemplified by Gibson and Nott's 10-page paper on the fourth antennular segment of the barnacle *Balanus balanoides* (L.), with 13 items in the reference list. The sensory organs of the fourth antennular segment are of prime importance in selecting settling grounds, and barnacles themselves, like the oysters, mussels and starfish that are the subject of many of these papers, are of economic importance as pests or food. This brings one to a third and unvoiced theme of this Symposium—a theme that will become more insistent as humans compete more fiercely with other organisms for food and space—the theme of economics. The N.E.R.C's Unit of Marine Invertebrate Biology in the Marine Science Laboratories at Bangor has, as its present research programme, the study of larvae, some of whose patterns of settlement and distribution are factors in farming the sea, elucidating food chains and foreseeing long-terms effects of pollution. The theme of light is also of at least indirect economic concern because so many forms of pollution involve turbidity and affect the growth of algae. Norton, Ebling and Kitching writing on the distribution of plants and animals in a sea cave in Co. Cork, demonstrate differing adaptations to light intensity by the algae, and the effect of their distribution on the fauna: in a much simplified form such a study could be attempted by the amateur conchologist, with useful comparative results. An ingenious new light trap for attracting and trapping, undamaged, zooplankton, has been designed and described by Jones: curiously one of the only species to appear in tow nets and not in the light trap, was the larva of the common winkle, *Littorina littorea* L., but there is no reason to suppose that it would not be effective in trapping mollusc larvae and anyone interested in plankton might well make their own light trap, following the clear diagram.

In his paper on the occurrence of bivalve larvae in the northern Adriatic Sea, Hrs-Brenko shows that they can be taken in every month of the year, some types occurring in almost every month, whilst others have a short high peak and yet others (*Musculus*) having two peaks. In a continuation of his work on parasitic flukes (Digenea) which have as their primary hosts certain prosobranch gastropods, Jams shows a remarkable degree of specificity, the parasites being destroyed in the "wrong" host.

The index was not found wanting in a test of twenty randomly selected items.

As a fruitful source of suggestion for new experimental techniques, this book is almost obligatory reading. Even the more serious of amateur Sub-Aqua Club members will often find a perusal of these papers time well spent. The typography is very good but not distinguished; the proof reading has the inevitable crop of oversights; the binding is of scholarly austerity but somewhat frail. The cost of this fine but not lavish volume? £12.40!! Surely this is one more indication that the great University presses that once confined themselves to such niceties as the italic comma (Oxford), have now entered the hurly-burly of commercial publishing. "Shades of the Pergamon begin to close . . ." as Wordsworth might have said!

STELLA M. TURK

Discovering Sea Shells by Barry Charles. (Shire Publications, Tring, Herts.). 1971. Price 25p.

The "Discovering" Series, now so well known, has itself the simplicity of many great discoveries which invites the question why nobody did it before. The Series is remarkably inexpensive, well illustrated and authoritatively written, and all this is true of the example reviewed.

It would be difficult, especially in a small book of this sort, to provide anything new and better in the way of species identification, and the author does not attempt it, merely providing descriptions of a few common shells at random to enable the beginner to see how shells in general may be split into genera and species. The discovering of shells is taken more literally as encompassing collecting methods, description of localities, record keeping, and a short list of museums where good collections may be seen. (A point here: the Shell Museum on Binstead Hill, Isle of Wight, is closed and the collection dispersed.)

It is pleasing to note the detailed explanation of the Society's Marine Recording Scheme and the invitation to all novice collectors to take part in it, but disappointing to note a perpetuation of the old fallacy, that conchology concerns iself with shells rather than with animals. The true derivation of the word is of course explained in S. P. Dance's *Shell Collecting,* 1966, p. 270.

The six classes of the mollusca are clearly set out although it is a pity that before doing so the author states that chitons are included with the gastropods; he also claims that there are three British species of cowry although he correctly lists two. Shell descriptions are good as far as they go and should whet the novice appetite to consult more detailed works such as those recommended; but it might have been a help in dealing with scallops to point out the easily noted difference between the two great genera.

The author includes a most useful map indicating selected collecting localities, and such a thing has been a need for years. Each year, for instance, the Society receives several queries from people wishing to spend their holidays at a good collecting spot and seeking advice on this matter. As the book is careful to point out, even good places can sometimes yield nothing!

The listing contains one slip in that it attributes Weymouth to Devonshire.

Most people are primarily interested in the shells they can find themselves but the title does not exclude tropical marine shells obtained by purchase and exchange; these activities receive some attention. The scarcity of a rare shell may increase or decrease "at a stroke" and the collector is encouraged to keep in touch with markets and museums. *Conus gloriamaris* is a case described: but only one specimen in the British Museum? Oh, fie!

Marine aquaria are not as difficult to keep as many people think and Mr. Charles has some useful and detailed advice to those wishing to keep their specimens alive rather than in boxes.

The book is altogether of such a useful nature that the reviewer hopes (as vainly before on other occasions) that it will be followed by a similar volume on the non-marine mollusca.

T. E. Crowley

Making Shell Flowers by Norma M. Conroy. Pp. 1–48, 82 illustrations. Little Craft Book Series, Oak Tree Press Co. Ltd., London, 1972 (Distributed by Ward Lock Ltd.). Price £1.05.

While it is clear that shells of all sorts and sizes lend themselves to the making of artificial flowers, this book shows the complete novice "how to begin". All the necessary materials (apart from the shells themselves) are listed in this pleasing little book, and every step in the construction and arrangement of the charming sprays and flower pieces is shown in detail.

It would perhaps be possible to make up any of these 'shell flowers" with the basic suggestion of four or five petals and a centre made from smaller shells or seeds, but Miss Conroy gives many examples similarly worked and these are illustrated in every case; unfortunately these photographs are not always as detailed as the instructions, and where the shells are given local names it is sometimes difficult to differentiate them. Probably it would have been wiser to use the scientific names as well, for most of the names in the book are quite unfamiliar in Britain. Some indeed, are quite misleading such as the shell we would call *Strombus alatus* in illustration 59, described as a Ramose Murex. "Gar* scales", relied on rather heavily in the arrangements, are probably not a species of shell, and certainly not easily available in this country.

Apart from these small exceptions, there is no reason why anyone with even very little imagination of their own should not be able to produce many attractive and unusual gifts and novelties to delight the eye.

E. M. Crowley

Oceanography, a view of the earth by M. Grant Gross (Prentice-Hall, Inc., New Jersey) 1972. £6.35. 581 pages. Hardback.

As stated in the preface to this new edition of *Oceanography*, the encompassing of all features of the sea and sea bed in one book is intended to provide a background to all the sciences of the oceans. This is indeed achieved. Much of the book is taken up with the geology of the ocean floor, the formation of the oceans and the chemical, physical and dynamic properties of ocean water including the whys and wherefores of currents and tides. One automatically thinks of the oceans as only comprising the deeper parts of the water-covered surface of the earth. Here the continental shelf, littoral regions and the development of coastlines are also described, with emphasis on U.S. shores. One is not aware that the seas are inhabited by any species other than *Homo quaestor* until p. 392, when the life of the oceans is reached via biochemical cycles and ecosystems: plankton; benthos; food economy; waste disposal and its effects. Molluscs appear as examples of points discussed. There are two minor appendices on metric systems and graphs, charts and maps, and the book ends with a comprehensive glossary which summarises the whole in a form suitable for answering exam questions. An index is provided. At the close of each chapter is a summary outline and selected up-to-date references.

The book is lavishly illustrated with photographs, drawings and diagrams. The majority of the latter are drawn freehand (why can't straight lines be ruled?) and are far below the standard required in the majority of British publications. There is also considerable editorial inattention to detail where illustrations are concerned. For instance Fig. 3-14, p. 70. Timor, the only island mentioned in the caption, is not named on the map. Fig. 11-13, p. 310, is upside down. Most conchologists will immediately spot that in Fig. 16-14, p. 452, *Tellina* is not on the right but the left. Spelling mistakes in names of animals also are present, and there is inconsistency between Latin and anglicised names, e.g. diatomacea and copopods (sic) in Fig. 17-1, p. 475. It would have been more meaningful if North were indicated in satellite photographs (Fig. 2-17, p. 46, where it lies towards the lower left).

In all, the idea and basic content of the book are excellent, but it is a pity it is marred by so many silly mistakes. The price, while not excessive for a book of this type, unfortunately places it out of range of the average student, and since individual disciplines are not discussed in depth some people would perhaps prefer to read a library copy and keep their money for a book to which they would refer more frequently.

SHELAGH SMITH

OFFICERS AND COUNCIL FOR 1972-1973

President:

T. E. Crowley, B.Sc., M.I.C.E.

Vice-Presidents:

J. W. Jackson, D.Sc., F.S.A., F.G.S.
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Hon. Treasurer:
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Mrs. N. F. McMillan, M.R.I.A.

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THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1971

	£	£	£
Publications:			
News Letter			391·61
Student Papers ...			54·76
Journal:			
Volume 26 No. 6 ...	586·30		
Authors Reprints ...	21·07	565·23	
Volume 27 No. 4 ...	615·92		
Authors Reprints ...	20·20		
	———	595·72	1,160·95
Bank Charges			7·40
Printing, Stationery and Postage			165·29
Officers Expenses			98·51
Subscriptions			7·00
			———
			1,885·52
Net Surplus			541·44
			———
			£2,426·96

	£	£
Fees and Subscriptions:		
Members Fees	1,361·25	
Subscribers	624·91	
Entrance Fees	21·00	
	———	2,007·16
Donations:		11·40
Sales:		
Advertising	0·75	
Journals	61·90	
Students Papers	33·37	
News Letter	13·86	
Sundry Receipts	0·60	110·48
Investment Income:		
General Account	256·06	
Life Members Fund	41·86	
Reserve and Research Fund ...	69·04	
	———	
	366·96	
Transfer to Reserve and Research Fund	69·04	297·92
		———
		£2,426·96

BALANCE SHEET AS AT 31st DECEMBER, 1971

		£
Fees and Subscriptions in Advance ...		144·61
Life Membership Fund		850·00
Reserve and Research Fund		1,239·74
Capital Account		
Balance Bt./Fwd.	4,341·72	
Add Surplus	541·44	
		4,883·16
		£7,117·51

	£	£
Cash at Bank: Current Account ...	355·52	
Deposit Account ...	2,389·07	
Cash in Hand	3·04	
		2,747·63
Investments:		
£400 5% Treasury Stock 1986/89 (£310·00)	344·00	
£500 5¾% Deb. Stock Mersey Docks and Harbour Board 1976/78	460·85	
£737 13s. 5d. 6¾% Stock Greater London Council (£561·00) ...	721·52	
2,514 Units M. & G. Dividend Fund (£1,970·00)	1,522·06	
£400 5⅝% Loan City of Norwich	400·00	
£800 5½% Loan London County Council	769·20	
420 Scot Income Units (£192·00)	152·25	
		4,369·88
		£7,117·51

Charles Pettitt } Hon. Auditors.
Wm. F. Edwards }

10 February 1972

Marjorie Fogan,
Hon. Treasurer.

J. Conch. 27: 556–567 (1972)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

870th (ORDINARY) MEETING, 20 MARCH 1971

Communications

"*Agriolimax caruanae* (Pollonera) and other non-marine Mollusca in Faroe" by Mrs. N. F. McMillan.

Lecture

"Some Aspects of Jurassic Ammonites" by Dr. J. T. Whicher, B.A., M.B., B.Chir. and illustrated with slides and specimens.

Members Elected

D. Gilbertson, B.A., Wendron, No. 1 Carlingcott, Peasedown St. John, Bath BA2 8AR, Somerset.
Hasan, Ahmed Kamel, Institute of Oceanography and Fisheries, Alexandria, United Arab Republic.

Member Deceased

D. H. Kennelly, Gately House, 1 Park Road, East London, South Africa.

Election of Officers

Due to the Postal strike the election of Officers was not held at the A.G.M. but held over until this meeting. The Officers were elected as follows:

President: Mr. T. Pain
Hon. Secretary: Miss J. T. Sawyer
Hon. Treasurer: Mrs. M. Fogan
Hon. Editor: Mrs. N. F. McMillan
Non-Marine Recorder: Dr. M. P. Kerney
Marine Recorder: Mrs. S. M. Turk

Council: Mr. T. E. Crowley
Mr. J. Llewellyn Jones
Mr. P. E. Negus
Mr. A. Norris
Mr. A. P. H. Oliver
Mrs. E. B. Rands

871st (ORDINARY) MEETING, 17 APRIL 1971

(Held at the City Museum, Leeds)

Communications

(a) "*Monodonta* (*Oxystele*) *fulgurata* Philippi, a synonym of *Oxystele variegata* (Anton)" by Brian Kelmsley of the South African Museum, Cape Town, and Mary-Louise Penrith of the State Museum, Windhoek.

(b) "A study of aquatic gastropod diets" by P. Reavell.

Lecture

"Parasites in Mollusca" by Dr. R. Wynne Owen, Leeds University, illustrated with slides.

MEMBERS ELECTED

R. I. F. Frazer, c/o Mr. and Mrs. Fuller, 6 Triq San Anard, Victoria, Gozo, Malta G.C.
Moon, Emeritus Professor H. P., "The Beeches", 48 Elmfield Avenue, Stoneygate, Leicester LE2 1RD.

872ND (ORDINARY) MEETING, 15 MAY 1971

Communications

(a) "The Distribution of *Helicodonta obvoluta* (Müll) in Britain" by R. A. D. Cameron.

(b) "Large *Cardium edule* and *Mytilus edulis*" by Mrs. N. F. McMillan.

(c) "The Rev. E. P. Blackburn and his Mollusc Collection" by C. A. B. Steel.

Lecture

"The role of Mollusca in Ancient Greek Art and Literature" by Mr. I. Cassells.

MEMBERS ELECTED

Dr. J. Aldous, 31 Warren Bank, Simpson, Bletchley, Bucks.
Dr. Karoly Baba, Szeged Uar u6, I.e.5, Hungary.
P. Greaves, 16 Chidswell Lane, Dewsbury, Yorks.
E. Lanfranco, via Cavour 6/8, 17100 Savona, Italy.
Lady Christina Letanka, 13 Eynsford Road, Farningham, Kent.
A. L. Metcalf, Dept. of Biology, University of Texas at El Paso, El Paso, Texas, U.S.A.
P. D. Read, B.Sc., Skerries, Chestnut Lane, Amersham, Bucks.

873RD (ORDINARY) MEETING, 16 OCTOBER 1971

Communications

(a) "A significance in the number of ribs on the shells of two closely related *Cardium* species" by P. J. C. Russell.

(b) "Two species of Gastropod Mollusc new to the Irish Fauna" by Dr. C. E. O'Riordan.

(c) "A proposed termination to the widely accepted junior synonomy of *Cardium parvum* to *C. exiguum*" by G. Høpner Petersen and P. J. C. Russell.

(d) "*Theba pisana* in Guernsey, 1971" by B. W. Barrett.

(e) "Dormancy in *Lymnaea peregra* (Müller) during periods of dryness" by R. Storey.

(f) "On the nomenclature of the Common Dog-Whelk" by J. H. Crothers.

(g) "*Vertigo lilljeborgi* (Westerlund) in N. Wales" by P. Dance.

(h) "The Cook voyages and Conchology, a supplementary note" by P. Dance.

(i) "Notes on the occurrence of *Vertigo geyeri* (Lindholm) in Ireland" by A. Norris and D. G. Pickerell.

(j) "Some fossil Molluscs from Muruarot Hill" by D. Van Damme and A. Gautier.

Lecture

"Some Problems with Persian Gulf Marine Mollusca" by the Rev. H. E. J. Biggs.

874TH (ORDINARY) MEETING, 13 NOVEMBER 1971

Communications

None.

Lecture

"Marine Mollusca found in Liverpool Bay" by L. D. Harfield.

ELECTIONS

A. R. Allcorn, 27 Kingston Avenue, Garlinge, Kent.
B. W. Barrett, B.Sc., Environmental Science Section, College of Education, Milton, Portsmouth.
G. Hallam, Brae Hill, 114 Old Road, Whaley Bridge, via Stockport, Cheshire SK12 7LF.
Mrs. M. Hart, Riverside, Rosea Bridge Lane, Combe Martin, N. Devon.
Mrs. G. S. Johansen, Aramco, Box 1663, Dhahiau, Saudi Arabia.
J. A. Keefe, 28 Burcott Road, Purley, Surrey CR2 4AA.
S. J. Long, 110 Cuyama Avenue, Pismo Beach, Ca. 93449, U.S.A.
T. Meyer, Philip Vingboonsstraat 50, Amsterdam 16, Holland.
G. Powell, I. Meyrick Avenue, Salisbury, Wilts.
Dr. G. Schiro, via Verbania 6, 1.00182 Roma, Italy.
Société Française de Malacologie, 55 rue Buffon, Paris 5e, France.
M. W. Storey, B.Sc., P.O. Box 270, Abu Dhabi, Arabian Gulf.
Dr. P. Vlasto, B.M.B.Ch.(Oxon), Wyke End, 20 Belle View Road, Weymouth.
D. J. K. Wickenden, Air Radio Bay, Airwork Services Ltd., R.A.F. Manby, Nr. Louth, Lincolnshire.
J. T. Whicher, M.A., M.B., B.Chir., 12 Windmill Lane, Blaire Dell, Henbury, Bristol.
R. H. Isaacs, c/o The British Council (Personnel Records), 65 Davies Street, London, S.E.23.

875TH (ORDINARY) MEETING, 18 DECEMBER 1971

Communications

None.

Lecture

"A shell collector in the Forces" by P. Cambridge, illustrated with slides.

ELECTIONS

P. F. Burns, 3 Copt Elm Close, Charlton Kings, Cheltenham, Glos.
R. H. Isaacs, c/o The British Council (Personnel Records), 65 Davies Street, London, W1Y 2AA.
Los Angeles Museum of Natural History, Library, 900 Exposition Boulevard, Los Angeles, California, 90007, U.S.A.
Dr. E. E. Sandor, 1 Fairlawn Drive, Woodford Green, Essex.
C. Ward, 37 Milburn Road, Kingstanding, Birmingham, B44 0UX.

Change of Officer

Following the resignation of Miss J. T. Sawyer from the post of Hon. Secretary, Mrs. E. B. Rands was appointed Acting Hon. Secretary until the Annual General Meeting.

876TH (ORDINARY) MEETING, 15 JANUARY 1972

Communications
None.

Lecture
"Corbulidae" by Dr. A. J. Rundle.

ELECTIONS

J. H. C. S. Cardita, Rua Tomás de Anunciacao 11-D-1 Lisboa/3, Portugal.
Mrs. E. Donoghue, 18 Maria Street, Kirkaldy, Fife, Scotland.
B. Fleischer, c/o Mr. Hildebrandt, Pestalozzistr 50, Gartengebäude, D-8000 München 5, Germany.
Captain C. J. Laurence-King, Lamerton Cottage, Longcross, Milton Abbot, Nr. Tavistock, Devon PL19 0PY.
J. Potter, 434 Southcoates Lane, Hull, E. Yorks.
Dr. rer. nat. Artur Roll, 3 Hannover-Kirchrode, Saarbruckenerstr. 2.

877TH (ANNUAL GENERAL) MEETING, 26 FEBRUARY 1972

In the Chair, the President, Mr. T. Pain, and 53 members and friends present.

Mr. T. Pain delivered his Presidential address entitled "The Origin and Distribution of Non-Marine Mollusca in South America".

Election of Auditors
Mr. W. F. Edwards and Mr. C. W. Pettitt were re-elected for 1972/73.

MEMBERS ELECTED

J. N. Allen, Mylkehouse, Sissinghurst, Kent.
G. V. Allen, 25 Highfield Way, Potters Bar, Herts.
F. Seidl, jun., A5280 Braunau am Inn, Fischer-Gasse 4, Austria.

MEMBER DECEASED

The death was announced of the Dowager Lady Iliffe.

REPORT OF THE COUNCIL 1971–72

Membership
It is with regret that the Society has to report the death of D. H. Kennelly who joined the Society in 1959. Membership now stands at 492. Forty-two members were elected during the past year, 27 resigned and 15 were removed from the lists for non-payment of subscriptions. The high number of resignations this year are largely due to the increased subscription rate.

Meetings
One Annual General Meeting and 3 Ordinary Meetings were held at the British Museum (Natural History), by kind permission of the Trustees. Because of the future high cost of hiring a room at the British Museum, following Government legislation, a new venue had to be found. As from October 1971 rooms have been hired from the Linnean Society of London in Burlington House and 4 ordinary meetings have been held there.

Publications

Two issues of the *Journal of Conchology*, Vol. 26, No. 6, and Vol. 27, No. 4, were published and quarterly *Conchologists Newsletters* were issued as usual, together with an Annual Membership listing and a syllabus of meetings.

Change of Officer

Mrs. E. B. Rands was appointed as Acting Secretary in December 1971 following the resignation of Miss J. T. Sawyer.

TREASURER'S REPORT, 1971

As mentioned in the Treasurer's Report for 1970, the Members' Annual Subscription and the rates for Subscribers to the *Journal of Conchology* were increased on 1 January 1971. As a result of these increases the Society's income from these sources shows an increase of approximately £700. The necessity of this action is shown by the Balance Sheet; had it not been taken the surplus of £541 on the year's accounts would have been replaced by a substantial deficit, and it should further be noted that the cost of hiring a room for meetings does not yet appear, and also that the cost of *Student Papers* is unusually small.

It is understood that another large increase in postal charges is forthcoming. This will materially affect the Society, and it is once more necessary to advocate continued economy.

The Council is alert to this necessity and is making every effort to avoid unnecessary expense. Members will observe that expenses on Field Meetings have been eliminated by a new method of notification. The Hon. Editor is constantly in touch with the printers, and has succeeded in putting into effect a series of minor economies in production which have kept *Journal* costs to a minimum without materially affecting quality. There is an appreciable rise in the figure for Officers' expenses; this is beyond their control, as it is entirely attributable to increased postage.

Covenanted Members have made a significant contribution, as the amount received from this source is only just under £100. Any Members who do not at present pay their Annual Subscriptions under Covenant are urged to consider this method of payment, as it is of great benefit to the Society and does not involve additional cost to the Members concerned. All Members are asked to assist by prompt payment of subscriptions, to avoid the cost of sending reminders.

Twenty-one Members and 3 Junior Members are at present in arrears, and will not receive publications until arrears are paid. Three Members became Life Members in 1971, and their Life Members' Subscriptions have been credited to the Life Members' Fund. It is regrettable that the increase in the Members' subscription has been seen to cause an unusually high number of resignations.

During the year the *Journal of Conchology*, Vol. 26, Part 6, made a belated appearance. Vol. 27, Part 4, was also published, and the issue of the forthcoming double part (Vol. 27, Parts 5/6) will mean that the Society should very shortly have overtaken publication delays. A large reserve has been maintained in the Deposit Account to allow payment for the delayed numbers, and when this has been paid it is hoped to be able to recommend an increase in the Society's investments.

MARJORIE FOGAN,
Hon. Treasurer

FIELD MEETINGS

Eight field meetings were held during 1971 as follows: 4 April, Sheppey, Kent (joint meeting with the Kent Field Club); 2 May, Hayley Wood, Cambridge; 21–23 May, coast of Pembroke; 5 June, Leicester area; 30 July, River Blackwater estuary, Essex; 14 August, Orford, Suffolk; 5 September, Thrapston, Northants; 17 October, Selborne, Hants.

Thanks are due to the following for leading these meetings: Miss J. T. Sawyer, and Drs. Joan Llewellyn-Jones, M. P. Kerney, A. Rundle, C. R. C. Paul, Messrs. I. Evans, P. Cambridge and G. Osborn.

Field meetings are also held by the Society's Yorkshire branch and the North-western Conchological Group. The latter held the following meetings: 13 March, Freshfield, Lancs.; 17 April, Southport (both led by N. F. McMillan); 8 May, Winsford, Ches. (led by K. G. Allenby); 6 June, Pennington Flash, Lancs. (jointly with the Lancs. Naturalists' Trust); 12 June, Alcumlow, Ches. (led by D. G. Pickrell); 26 June, Ainsdale National Nature Reserve; 21 August, Nob End, Lancs. (jointly with Lancs. Naturalists' Trust); 4 September, Claughton and Clevely Mere, Lancs. (led by E. R. Greenwood); 9 October, Alderley Edge and Bollington, Ches. (led by M. Fogan); 30 October, Compstall Nature Reserve (led by the Warden); 11 December, Southport (led by N. F. McMillan).

T. Pain

REPORT ON JUNIOR MEMBERSHIP, 1971–1972

Membership

During the year 18 new members have been elected: 3 have become full members, 5 have resigned and 1 removed for non-payment of dues. This leaves a total of 58 junior members in good-standing, being our highest since the inception of junior membership in 1964.

"Papers for Students"

There has been no new issue in 1971 but No. 14, on the mollusca of rocky and sandy shores, is expected early in 1972.

Publicity

Although no new publicity has been initiated this year it is gratifying to know that books for young collectors which have been published in recent years continue to be the chief source of new juniors.

Sales of "Papers for Students"

Sales amounted to £31.49, less than last year but still satisfactory. The drop was, I think, due to lack of publicity normally given to all the papers when a new one comes out and gets mention in journals circulating in schools.

H. E. J. Biggs

RECORDER'S REPORT: NON-MARINE MOLLUSCA

A. 10-Kilometre Square Mapping

The 1971 season saw another 10,000 records incorporated. Progress therefore remains fairly satisfactory, although, as before, the north and west of the British Isles has been neglected in contrast to the south-east. Two special mapping expeditions were made to Ireland, in March and in August, the latter aided by a grant from the Praeger Fund of the Royal Irish Academy.

B. Vice-County Records

The following new records have been verified since the last Recorder's Report (*J. Conch.*, **27** : 444). Unless otherwise stated, the date of collection was 1971.

Somerset South (5) : *Vertigo substriata*, Clovenrocks Bridge (21/7839), S. P. Dance; *Arion lusitanicus*, Yeovil (garden; 31/5416), M. P. Kerney.

Somerset North (6) : *Anodonta complanata*, R. Yeo (31/4623), D. R. Seaward.

Wilts South (8) : *Pisidium tenuilineatum*, R. Avon (41/1429). J. Bass.

Dorset (9) : *Vertigo substriata*, Mapperton (31/5200), D. R. Seaward; *Pisidium moitessierianum*, Fifehead Magdalen (31/7920), M. P. Kerney.

Hants North (12) : *Agriolimax caruanae*, Selborne (41/7433), R. Preece.

Suffolk West (26) : *Milax budapestensis*, Risby (52/8066); *Pisidium supinum*, Little Ouse, Hockwold (52/7286), M. J. and S. J. Bishop.

Norfolk West (28) : *Theodoxus fluviatilis*, Great Ouse, Southery Fens (52/6193); *Viviparus viviparus*, *Unio pictorum*, *Unio tumidus*, Great Ouse, Hilgay (52/5998); *Milax budapestensis*, Tilney All Saints (53/5617), M. J. and S. J. Bishop, 1972.

Cambridge (29) : *Pisidium moitessierianum*, R. Cam, Trumpington (52/4354), C. R. C. Paul.

Gloucester East (33) : *Truncatellina cylindrica*, North Church Common and Cleeve Hill (32/92), J. S. Hawkins, 1861 (British Museum collection); *Lauria sempronii*, Haresfield Beacon (32/80), A. G. Stubbs, 1894 (Leeds City Museum).

Salop (40) : *Vertigo substriata*, *Lauria anglica*, Neen Sollars (32/6771), I. D. Finney.

Montgomery (47) : *Vertigo substriata*, Dolanog (33/0712); *Vallonia costata*, Newtown (32/1091), S. P. Dance.

Caernarvon (49) : *Pisidium pulchellum*, Llyn Glasfryn (23/4042), S. P. Dance.

Denbigh (50) : *Acanthinula lamellata*, Conway Falls (23/8053), S. P. Dance.

Leicester (55) : *Monacha granulata*, Blaby (42/5698), Mrs. E. B. Rands; *Pisidium supinum*, R. Wreake, Hoby (43/6717), M. P. Kerney.

York North-east (62) : *Phytia myosotis*, Whitby (45/8512), A. Norris.

York Mid-west (64) : *Limax tenellus*, Pateley Bridge (44/1564), J. Armitage.

York North-west (65) : *Vertigo alpestris*, Bolton Beck (44/0492), 1952; *Pisidium pseudosphaerium*, Croft (45/2708), R. H. Lowe, 1970).

Durham (66) : *Vitrea diaphana* (form *subrimata*), Stanhope (35/9840), R. H. Lowe.

Northumberland South (67) : *Vitrea diaphana* (form *subrimata*), Whittle Dene (45/0765), E. P. Blackburn, *ca.* 1930 (Sunderland Museum).

Westmorland (69) : *Planorbis laevis*, Ullswater (35/3918), L. Lloyd-Evans.

Perth Mid (88) : *Vallonia excentrica*, Struan (27/8065), Mrs. E. B. Rands.

Perth East (89) : *Sphaerium lacustre*, Blair Castle (27/8666), Mrs. E. B. Rands.

Banff (94) : *Cepaea nemoralis*, Knock (38/5452), E. Kellock.

Mid Ebudes (103) : *Milax gagates*, Bunessan, Mull (17/3822), Mrs. E. B. Rands.

Sutherland West (108) : *Vallonia costata*, Balnakeil Bay (29/3970), Mrs. A. M. Brockbank.

Caithness (109) : *Lauria anglica*, Lybster (39/2435); *Hygromia hispida*, Scarmclette Loch (39/1860); *Milax gagates*, Thurso (39/1167); *Milax sowerbyi*, Scrabster (39/0969), R. G. Meiklejohn.

Outer Hebrides (110). *Limax flavus*, Craigston, Barra (08/6601), A. R. Waterston.

Unless stated otherwise * all the following Irish records were made during the Conchological Society expeditions in March and in August.

Kerry North (H 2) : *Succinea oblonga*, Causeway (Q 8028); *Vertigo moulinsiana*, Causeway (Q 8229); *Vallonia pulchella*, Buncurrig marshes (Q 7526); *Cecilioides acicula*, Castleisland (Q 9411); *Milax budapestensis*, Milltown (Q 8200); *Sphaerium lacustre*, Ardfert (Q 7821).

Waterford (H 6) : *Vitrina pyrenaica*, Belleville Park, Cappoquin (X 1299).

Tipperary South (H 7) : *Planorbarius corneus*, Bansha (R 9533); *Monacha granulata*, *Agriolimax caruanae*, Caher (S 0424); *Milax budapestensis*, Tipperary (R 8935).

Limerick (H 8) : *Succinea oblonga*, Abbeyfeale (R 1127); *Vallonia excentrica*, *Milax budapestensis*, *Agriolimax caruanae*, Hospital (R 7036).

Tipperary North (H 10) : *Vallonia pulchella*, *Milax budapestensis*, Modreny (R 9589).

Kilkenny (H 11) : *Agriolimax caruanae*, Castlecomer (S 5372).

Carlow (H 13) : *Milax budapestensis*, Tullow (S 8473).

Leix (H 14) : *Potamopyrgus jenkinsi*, Borris in Ossory (S 2386); *Vertigo pusilla*, Attanagh (shell in flood debris); (S 4276); *Oxychilus draparnaudi*, Castletown (S 3492); *Milax budapestensiss*, Rathdowney (S 2976); *Agriolimax caruanae*, Mountmellick (N 4507).

Offaly (H 18) : **Vertigo geyeri*, Roscrea (S 1690), A. Norris, 1970; *Potamopyrgus jenkinsi*, Sharavogue (S 0596); *Vallonia excentrica*, Shinrone (S 0893); *Agriolimax caruanae*, Portarlington (N 5412).

Kildare (H 19) : *Pisidium pulchellum*, Kill (N 9244).

SEGREGATE SPECIES

Carychium, *Cochlicopa*, *Vitrea*. It is now clear that the segregates of these ubiquitous genera are present in all or nearly all vice-comital divisions. No further records will therefore be published.

Columella. Records of the segregate forms *Columella edentula* (Draparnaud) *seg.* and *C. aspera* Waldén are being accumulated. Specimens for verification should be sent to Dr. C. R. C. Paul, who is organising the recording of this genus.

Arion fasciatus Nilsson *seg.* (the form of *Arion "circumscriptus"* with yellowish or brownish pigment). Records verified by Dr. June Chatfield, Dr. L. Lloyd-Evans or Mr. A. E. Ellis are as follows : 15, 17, 30, 32, 37, 38, 39, 44, 50, 51, 53, 55, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 69, 70, 75, 80, 81, 85, 90, 91, 94, 106, 109, 112 and H 31. The species appears to be common in the north of England and in Scotland, scarce in the south of England, and very rare in Ireland.

The outstanding discovery of 1971 has been that of *Lauria sempronii* (Charpentier) from Gloucestershire, based on specimens collected in 1894. *L. sempronii* is an Alpine and south European species. It was previously known in Britain only as a Postglacial fossil. For a fuller account, see *J. Conch.* **27** : 517–8.

The new records of *Vitrea diaphana* from Durham and Northumberland show that the species probably has a wide distribution in the northern Pennines. All British specimens so far seen belong to the form *subrimata*, in which the umbilicus is not entirely closed.

Mr. Lowe's find of *Pisidium pseudosphaerium* in a pond in north Yorkshire considerably extends the known range of this species. *Pisidium tenuilineatum* in the Wiltshire Avon is also noteworthy.

Cepaea nemoralis has been found at an isolated site in Banffshire. It is common in an old railway yard, but nowhere else in the vicinity, and may be an introduction.

Several interesting discoveries resulted from the expeditions to Ireland. The most important is *Vitrina* (*Semilimax*) *pyrenaica* in a wood near Cappoquin, Co. Waterford, the first known station in the south-east of Ireland (*Ir. Nat. J.*, in press). The species was also detected at a new site in Kerry (H 2). These finds, which are in relatively "natural" habitats, strengthen the idea that *V. pyrenaica* is indigenous in Ireland, and not a recent casual introduction, as the highly disturbed nature of the Meath/Louth stations originally suggested.

Succinea oblonga, new to H 2 and H 8, was found to be remarkably common in parts of south-west Ireland, especially in north Kerry, where it occurs freely in damp places well away from any standing water. Old quarries are a characteristic habitat. The new record of *Vertigo moulinsiana* in H 2 is also of interest, at a site right outside the main area of distribution on the central plain.

M. P. KERNEY

RECORDER'S REPORT: MARINE MOLLUSCA

(A.G.M., 19 February 1972)

10-KILOMETRE SQUARE MAPPING

The list of species for coding was forwarded to the Biological Records Centre in December 1971, and cards for use in field work should be available this Summer, together with a special version of the 80-column card which carries details of the individual record: this last has been modified for the recording of all marine fauna by the Marine Biological Association in conjunction with the B.R.C. and in consultation with the Conchological Society. Work is nearly completed on a concordance, the production of which will coincide as nearly as practicable with the issue of the field cards, and which will provide modern equivalents of the familiar Winckworth list names used on the cards.

CENSUS AREA RECORDS

The following notes name those who have submitted lists and, where necessary, specimens for verification between February 1971 and February 1972. New records are given only for those Areas for which reasonably complete lists exist, and specific names are preceded by the Winckworth list number.

Orkney, C.A.3: D. W. McKay; R. G. Meiklejohn; A. Skene. A species new to Orkney is G.69 *Rissoa sarsii*, found in numbers in shell sand by Mr. Skene and determined by Mrs. N. F. McMillan by reference to Marshall material in Liverpool Museum.

Moray Firth, C.A.5: D. W. McKay; R. G. Meiklejohn. Nearly 300 species have now been listed, and although many are 19th century and of uncertain status, they are acting as a basis for comparing incoming records.

Firth of Forth, C.A.7: Since Dr. Shelagh Smith published her long list in *Conch. Newsletter* No. 38 (September 1971) she has reported two living examples of L.60 *Thyasira flexuosa* from the Firth of Forth in 5½ fms.

Northumberland, C.A.9: P. G. Moore; Sqn. Ldr. D. A. J. Taylor. Mr. Moore's records for both this Area and C.A.11 all pertained to living species retrieved from holdfasts of *Laminaria*: the investigation of holdfast faunas on a comparative basis can be an important biological indication of pollution. Of special note is the find of a living example from St. Abbs, of G.82 *Ammonicera rota*, a species considered by Fretter and Graham, 1962 (*British prosobranch molluscs*) to be confined to south-west England and S. Ireland, but given a wider range by Jeffreys, 1867 (*British Conchology* 4:71): this record lends credence to a 19th century report of the species from Scarborough in C.A.11.

Yorkshire, C.A.11: A. Norris; P. G. Moore. A list of nearly 300 species has now been compiled for this Area, thanks to Mr. Norris's active help.

Wash, C.A.12 : A. Norris; Sqn. Ldr. D. A. J. Taylor. Mr. Norris is helping to compile records from the Yorkshire part of the coast. Dr. R. Hammond has almost completed a comprehensive list for the whole of C.A.12, and he has kindly allowed the Recorder to keep a copy of his typescript in the Census files, prior to its publication.

Thames, C.A.13 : Rev. H. E. J. Biggs.

Wight, C.A.15 : Mrs. J. L. Charlish has submitted one new Area record (G.60 *Alvania beani*, one shell from Weymouth) and some new 20th century records.

Portland, C.A.16 : G. Dinesen; Mrs. C. Pain; D. R. Seaward. Over 300 species have now been listed. Mrs. Pain and Mr. Seaward have upgraded several existing records, and Mr. Seaward also submitted Voucher specimens of several nudibranchs from Sandsfoot, Dorset including G.268 *Hermaea dendritica* and G.271 *Elysia viridis*, both new to the Area.

Channel Isles, C.A.17 : J. E. Llewellyn Jones.

West Channel, C.A.18 : B. Bolitho; M. Christie; G. Dineson. Mrs. McMillan reports (*J. Conch.* **27** : 266) the finding of a minute valve of the anomiid *Isomonia alberti* Dautzenberg and Fischer, in the Salisbury Collection in Liverpool Museum, labelled "Towan, Falmouth" : it is recorded by Nordsieck only from the Azores. From the same collection a single valve of the lucinacean *Ctena decussata* (O. G. Costa) was discovered, labelled "Towan Beach, Falmouth 1912". Although obviously not too much weight can be placed on the finding of a single example, especially when imperfect, reporting such does serve as a basis for further appraisal when subsequent finds are made (see C.A.19 below). Two shells, also from the Salisbury collections, labelled "*Eulimella nitidissima* Plymouth Sound 25–30 fms." were given to the Recorder recently by Major P. K. Earle : one of these was confirmed by Dr. V. Fretter as G.105 *Graphis albida* and donated to the Marine Biological Association's collections as it represented a species new to the Plymouth area. Valves of *Lima* sp. collected from shell sand at Polurrian, The Lizard by Mrs. J. Charlish, have been confirmed as L.53 *Lima sulcata* by Dr. J. Rosewater although he adds that this species is not easily distinguishable from *L. subauriculata*, of which there are 19th century reports from the south Cornish coast and Scilly (see under C.A.19).

Scilly Isles, C.A.19 : Mrs. C. Pain; Sqn. Ldr. D. A. J. Taylor. Mrs. Pain contributed five new 20th century records, and Sqn. Ldr. Taylor a further seven. Mrs. McMillan has published evidence 1971 (*J. Conch.* **27** : 272) for adding two further species to the British list. Marshall, 1897 (*J. Conch.* **8** : 369) found two valves of *Tellina serrata* Bronchi and recently Mrs. McMillan has discovered a complete example given to her by the late W. Fowler; there is strong circumstantial evidence that he collected it from Scilly, probably in the late 1940s, or early 1950s. In the Salisbury Collection in Liverpool Museum Mrs. McMillan further reports (*J. Conch.* **27** : 266) a specimen of *Ctena decussata* taken alive at Scilly (see C.A.18 above). Valves of L.53 *Lima sulcata*, collected by Sqn. Ldr. Taylor, have been confirmed by Dr. Rosewater, are new to C.A.19 (see entry under C.A.18).

North Cornwall, C.A.20. Nearly 230 specimens have been listed so far, but although most are 20th century, nearly all are shells only : 19th century reports of the same species are mostly from famous "shell sand" beaches, and one suspects that they too were based on shells. Some, indeed, such as L.89 + *Cardium papillosum* and L.141 + *Mactra glauca* may be subfossil, and now a third considered by Mrs. McMillan (*J. Conch.* **27** : 266) possibly to belong to this category is the erycinacean *Bornia sebetia* (O. G. Costa), found on Hayle Beach at the end of the 19th century by the geologist A. Bell.

Bristol Channel, C.A.21 : Mrs. J. L. Charlish; J. H. Crothers; Dr. Joan Llewellyn Jones; Sqn. Ldr. D. A. J. Taylor. New for the Area are G.71 *Alvania cancellata*, one shell, also new for 10 km. square 12/70, the Dale Fort District (Sqn. Ldr. Taylor) : G.77 *Paludinella littorina*, one shell from Putsborough, Woolacombe, Devon (Mrs. Charlish) : G.140 *Odostomia plicata*, living on *Pomatoceros*, Porlock Weir, Somerset (Mr. Crothers) : G.142 *O. unidentata*, living, and also new to 10 km. square 12/70 (Sqn. Ldr. Taylor) : G.320 *Dendronotus frondosus*, living on *Tubularia* at Watchet, Somerset (Mr. Crothers).

Cardigan Bay, C.A.22 : Mrs. J. Charlish; Dr. Joan Llewellyn Jones. New records to the list published in *Conch. Newsletter* No. 34 (September 1970) are G.54 *Cingula proxima*, one shell from Mochras (Mrs. Charlish) : G.161 *Turbonilla crenata*, one shell (Dr. Llewellyn Jones) authenticating another of J. J. Cotton's records in the above list. Dr. Llewellyn Jones submitted this last specimen with a number of others resulting from a Field Meeting held on the Pembrokeshire coast, 21–23 May 1971 : the meeting was led by Miss J. T. Sawyer whose report, listing many species from C.A.s 21 and 22 will appear shortly in the *Conch. Newsletter*.

Anglesey, C.A.23 : Coningsby Sub Aqua Club (per Sqn. Ldr. D. A. J. Taylor); Sqn. Ldr. Taylor. So far only a skeleton list has been compiled in the Census files, but several new records have been added this past year.

Solway, C.A.25 : E. G. Hancock (per Mrs. McMillan).

Clyde and Argyll, C.A.29 : Mrs. J. L. Charlish; D. W. McKay; P. G. Moore; Miss B. Rae. An extensive series of records are currently being submitted by Miss Rae, resulting from her own collecting as well as that of the Scottish Marine Biological Station at Dunstaffnage Laboratory : these already include new 20th century records. Mrs. Charlish has supplied some new species for Magilligan Strand. Mr. McKay has submitted some new 20th century records and also an important discovery of G.119 *Balcis anceps* off Arran in 1971 : the only other British report of the species is that of Marshall who originally described the species in 1901 (*J. Conch.* **10** : 124) from an example taken in the selfsame locality. (N.B. It is not included by Allen, 1962 *Fauna of the Clyde Sea Area: Mollusca*.)

Minch, C.A.30 : S. Angus; D. W. McKay; R. Preece; M. Willing; A. Skene; Dr. Shelagh M. Smith. Submitted lists contained a number of 20th century additions to the list so far compiled which, with over 200 records, is becoming better based. The most interesting find was that of L.11 *Limopsis aurita* (two valves) found by R. Preece and M. Willing at Skye in 1969, and recently checked by Dr. J. Rosewater; previously it seems to have been known only from Shetland.

Lewis, C.A.31 : S. Angus.

Uist, C.A.32 : S. Angus; D. W. McKay. Like C.A.31, this is still very under-recorded for unfortunately many early literature references cite only "Outer Hebrides" in general, and one cannot determine whether C.A.30, 31 or 32 is intended. An outstanding find is G.61 *Alvania jeffreysi*, two shells from White Strip Bank of 180 m. (Mr. McKay). This is a very rare species, previously known only from C.A.s 1 and 19.

An indication of one of the uses to which the store of records and network of recorders may be put, was shown in a recent letter (19 January 1972) from Mr. F. Berry of the Nature Conservancy London Office. He writes that owing to considerable pressure by the public to examine deleterious trends in marine life, the Natural Environment Research Council has set up a Working Party to investigate this and the feasibility of applying conservation measures. The Nature Conservancy has undertaken to collate summaries of evidence from such groups as the Conchological

Society, and Mr. Berry asks for our cooperation in general. Knowing the Society's attitude towards conservation, it was possible to indicate willingness, and possible ways of helping through the medium of the present recording scheme.

Members will be pleased to know that Prof. A. Graham's illustrated key "British prosobranchs and other operculate molluscs" has now been published: it is No. 2 of the Linnean Society's Synopses of the British Fauna (New Series), and is available from the Academic Press, 24–28 Oval Road, London, N.W.1. for £1.30.

Thanks are due to Dr. Vera Fretter for varied help, including the checking and identifying of the rarer prosobranchs, and to Dr. J. Rosewater, Curator of Mollusca, Smithsonian Institution for comparing certain species with examples in the Jeffreys Collection. Mrs. J. L. Charlish, Mr. C. D. Drake and Mr. H. B. Sargent all helped to sort and name species from off-shore substrate; Mr. Sargent in particular has spent an enormous amount of time and trouble on such samples, collected by the R.A.F. Sub Aqua Clubs under the leadership of Sqn. Ldr. D. A. J. Taylor. The 1971–72 session has been a particularly arduous one for the Marine Census Sub-Committee, who are thanked, together with Dr. F. H. Perring and Mr. J. Heath of the Biological Records Centre for coping with the negotiations over the nomenclature and form of the field cards, which involved all concerned in a great deal of correspondence.

STELLA M. TURK

J. CONCH. **27**: 568 (1972)

REVIEW

Die europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae; Rissoacae) Vom Eismeer bis Kapverden, Mittelmeer und Schwarzes Meer. Von Dr. Fritz Nordsieck. Pp. xiv, 327; 1,100 pen-and-ink drawings; 4 col. plates. Stuttgart, 1972. Price DM 74.

Dr. Nordsieck's latest volume on European marine Mollusca will be warmly welcomed. It comprises the Opisthobranchia (524 spp.), the Pyramidellidae (178 spp.) and a revision of the Rissoacae (320 spp.). In Part I, covering the opisthobranchs, there are four coloured plates illustrating 63 opisthobranchs; these are rather gaudy to one used to Alder & Hancock's elegancies, but are quite adequate. The remaining figures (black-and-white) of opisthobranchs are valuable in that they give also details of radula, cerata and rhinophore.

Part II deals with the Pyramidellidae. A well-illustrated survey of the group has long been needed and Dr. Nordsieck has now given us one. Where the host-species is known this is stated, but it is sadly obvious how little we know, on the whole, of the domestic affairs of these interesting molluscs. Several new species and subspecies are described and some species have been re-named where this has been necessary.

Part III is a revision of the Rissoacea, and supersedes the account in vol. I of Dr. Nordsieck's trilogy. Here one notes that *Hydrobia neglecta* Muus is regarded as a form of *H. minuta* (Totten, 1834); the latter was recorded as British by A. S. Kennard many years ago but the record was always treated, perhaps unfairly, with suspicion. Dr. Nordsieck gives the range of *H. minuta* as Scandinavia to the Mediterranean. *Peringia* replaces the familiar *Hydrobia* for our *ulvae* of Pennant.

"Rissoa" as a whole is arranged here in five subfamilies, three of them new, and a number of new subgenera, species and subspecies are described. The figures are pleasantly clear and together with the descriptions should enable one to determine the species with reasonable ease.

Dr. Nordsieck's work is both thorough and comprehensive. Every serious worker on marine Mollusca needs this volume, as well as the two previous ones (*Die europäischen Meeres-Gehauseschnecken* (*Prosobranchia*) (1968) and *Die europäischen Meeresmuscheln* (*Bivalvia*) (1969)).

NORA F. MCMILLAN

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CORRECTIONS

Page	
17	line 2 from foot: for '*ruperestris*' read '*rupestris*'
87	top: for '1969' read '1970'
126	line 10: for 'that' read 'than'
133	line 3: for 'Drapernaund' read 'Draparnaud'
173	Table 1: for '*Onoris*' read '*Ononis*'
195	first line of References: for 'habits' read 'habitats'
238	line 8: for '1967' read '1867'
262	line 12 from foot: for '*cornem*' read '*corneum*'
283	line 28: for 'Newletter' read 'Newsletter'
285	line 21: for '*Agriolimax*' read '*Arion*'
287	line 6: for '*lillpeborgi*' read '*lilljeborgi*'
362	last paragraph, line 2: for 'their' read 'these'
374	bottom line: for 'inevitable' read 'inevitably'
378	transpose legends of figures 1a and 1b
397	Title, first line: for 'to' read 'of'; third line: for 'to' read 'with'
418	line 3 from foot: for 'mind' read 'mine'
449	line 8 from foot: for '*Punctuella*' read '*Puncturella*'
534	bottom line: for 'C' read 'E'
568	lines 2 and 7: for 'Rissoacae' read 'Rissoacea'

See also page 451

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